

# VERIFICATION OF COMPLIANCE

Equipment : WiFi6 11ax 2T2R module 1800Mbps  
Model No. : AW7915-NPD  
Applicant : AsiaRF Co., Ltd.  
1F, 7, Houde Street, Yonghe Dist. New Taipei City Taiwan 23455

**I HEREBY****DECLARE THAT :**

The equipment was **Passed** the test performed according to the following Standard  
**ETSI EN 301 489-1 V2.2.3 (2019-11) Class B,**  
**ETSI EN 301 489-17 V3.2.4 (2020-09)**

The test was carried out on **Apr. 21, 2022** at **SPORTON INTERNATIONAL INC.**  
**Hsinhua Laboratory.**

  
William Li





# EMC TEST REPORT

**Equipment** : WiFi6 11ax 2T2R module 1800Mbps  
**Brand Name** : AsiaRF Co., Ltd.  
**Model Name** : AW7915-NPD  
**Applicant** : AsiaRF Co., Ltd.  
1F, 7, Houde Street, Yonghe Dist. New Taipei City  
Taiwan 23455  
**Manufacturer** : AsiaRF Co., Ltd.  
1F, 7, Houde Street, Yonghe Dist. New Taipei City  
Taiwan 23455  
**Standard** : ETSI EN 301 489-1 V2.2.3 (2019-11) Class B  
ETSI EN 301 489-17 V3.2.4 (2020-09)

The product was received on Mar. 28, 2022, and testing was started from Apr. 07, 2022 and completed on Apr. 21, 2022. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in above standards and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Hsinhua Laboratory, the test report shall not be reproduced except in full.

Approved by: William Li

**SPORTON INTERNATIONAL INC. Hsinhua Laboratory**  
No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)



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### History of this test report

Report No.	Version	Description	Issued Date
EH211912	01	Initial issue of report	Jun. 27, 2022

## SUMMARY OF TEST RESULT

Report Clause	Ref Std. Clause	Test reference standard	Test Items	Result (PASS/FAIL)	Remark
<b>Emission Tests and Conformance Test Specifications</b> <b>ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09)</b>					
4.1	8.4 8.3	EN 55032:2015 Class B	Conducted Emission	PASS	Under limit 15.74 dB at 0.15 MHz
-	8.7		Conducted Emission (wired network ports)	Not Applicable	Note 1
4.2 & 4.3	8.2		Radiated Emission	PASS	Under limit 4.56 dB at 249.600 MHz
-	8.5	EN 61000-3-2:2014	Harmonic Current Emissions	Not Applicable	Note 2
-	8.6	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	Not Applicable	Note 2
Note 1: There are no wired network ports on the EUT.					
Note 2: After fixed installation or following the instructions for use, the power is provided by the host system.					

Report Clause	Ref Std. Clause	Test reference standard	Test Items		Result (PASS/FAIL)	Remark
Immunity Tests and Conformance Test Specifications ETSI EN 301 489-1 V2.2.3 (2019-11) ETSI EN 301 489-17 V3.2.4 (2020-09)						
6.1	9.3	EN 61000-4-2:2009	ESD (Enclosure)		PASS	-
6.2	9.2	EN 61000-4-3:2006/A2:2010	RS (Enclosure)		PASS	-
-	9.4	EN 61000-4-4:2012	EFT/B	DC and AC power ports	Not Applicable	Note 1
				Signal, wired network and control ports	Not Applicable	Note 2
-	9.8	EN 61000-4-5:2014/A1:2017	Surge	AC power ports	Not Applicable	Note 1
				Signal, wired network and control ports	Not Applicable	Note 2
-	9.5	EN 61000-4-6:2014	CS	DC and AC power ports	Not Applicable	Note 1
				Signal, wired network and control ports	Not Applicable	Note 2
-	9.7	EN IEC 61000-4-11:2020	DIP & Interruptions (AC Power Port)		Not Applicable	Note 1
According to the applicant's requirements, the version of the normative reference used in this test report is specified by the applicant.						
Note 1: After fixed installation or following the instructions for use, the power is provided by the host system.						
Note 2: There are no Analogue/digital data ports on the EUT.						

**Declaration of Conformity:**

1. The Radiated Emission and Conducted Transient Disturbances test result (Pass/Fail) which exclude measurement uncertainty. Note that measurement values may risk exceeding the limit of regulation standard. If measurement uncertainty is included in test results.
2. The Radiated Emission and Conducted Transient Disturbances measurement uncertainty please refer to the "Measurement Uncertainty" section of the report.

**Comments and explanations:**

1. The test configuration and test mode were recorded in this test report are declared by the manufacturer.
2. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Mark Ma****Report Producer: Debby Hung**

## 1. General Description of Equipment under Test

### 1.1. Basic Description of Equipment under Test

Equipment : WiFi6 11ax 2T2R module 1800Mbps  
 Model No. : AW7915-NPD  
 Power Supply Type : From Host System  
 The maximum operating frequency : 5.85 GHz

### 1.2. Feature of Equipment under Test

Group	Ant.	Brand	Model Name	Antenna Type	Connector	Support	Cable Loss (dBi)
1	1-2	Asiarf	ANT010-DAU	PCB	I-PEX / MMCX	2.4G+5G	0.3
2	3-4	Asiarf	ANT003	PCB	I-PEX / MMCX	2.4G+5G	0.3
3	5-6	Asiarf	A245005N	PCB	I-PEX / MMCX	2.4G+5G	0.3
4	7-8	Asiarf	A2405N	PCB	I-PEX / MMCX	2.4G	0.3
5	9-10	Asiarf	A5005N	PCB	I-PEX / MMCX	5G	0.3
6	11-12	Asiarf	A245004	Dipole	I-PEX / MMCX	2.4G+5G	0.3
7	13-14	Asiarf	A245002	Dipole	I-PEX / MMCX	2.4G+5G	0.3

For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

### 1.3. Table for Multiple Listing

SKU	Ant. Connector	Description
1	I-PEX	There are two SKUs for EUT. The only difference between SKU 1 and SKU 2 is Ant. Connector, but the gain is same.
2	MMCX	

Note 1: The information is provided by manufacturer.

Note 2: After evaluation, only SKU1 is required to be tested.

## 2. Test Configuration of Equipment under Test

### 2.1. Details of EUT Test Modes

Model No.: AW7915-NPD was selected as the main test model and its data was recorded in this report. The equipment under test was performed the following test modes:

Test Items	Description of test modes
<b>Conducted Emission</b>	Mode 1. PCB antenna(ANT010-DAU),WiFi2.4G&5G Mode 2. Dipole antenna(A245004),WiFi2.4G&5G Mode 3. Dipole antenna(A245002),WiFi2.4G&5G Mode 4. PCB antenna(A245005N),WiFi2.4G&5G Mode 5. PCB antenna(ANT003),WiFi2.4G&5G Mode 6. PCB antenna(A2405N),WiFi2.4G Mode 7. PCB antenna(A5005N),WiFi5G cause "mode 1" generated the worst test result; it was reported as final data.
<b>Radiated Emissions &lt;below 1GHz&gt;</b>	Mode 1. PCB antenna(ANT010-DAU),WiFi2.4G&5G Mode 2. Dipole antenna(A245004),WiFi2.4G&5G Mode 3. Dipole antenna(A245002),WiFi2.4G&5G Mode 4. PCB antenna(A245005N),WiFi2.4G&5G Mode 5. PCB antenna(ANT003),WiFi2.4G&5G Mode 6. PCB antenna(A2405N),WiFi2.4G Mode 7. PCB antenna(A5005N),WiFi5G cause "mode 1" generated the worst test result; it was reported as final data.
<b>Radiated Emissions &lt;above 1GHz&gt;</b>	Mode 1. PCB antenna(ANT010-DAU),WiFi2.4G&5G The measurement of radiated emissions above 1GHz follows the test configuration for the worst test results below 1GHz.

Test Items	Description of test modes
<b>EMS</b>	Mode 1. PCB antenna(ANT010-DAU),WiFi2.4G&5G



## 2.2. Description of Test System

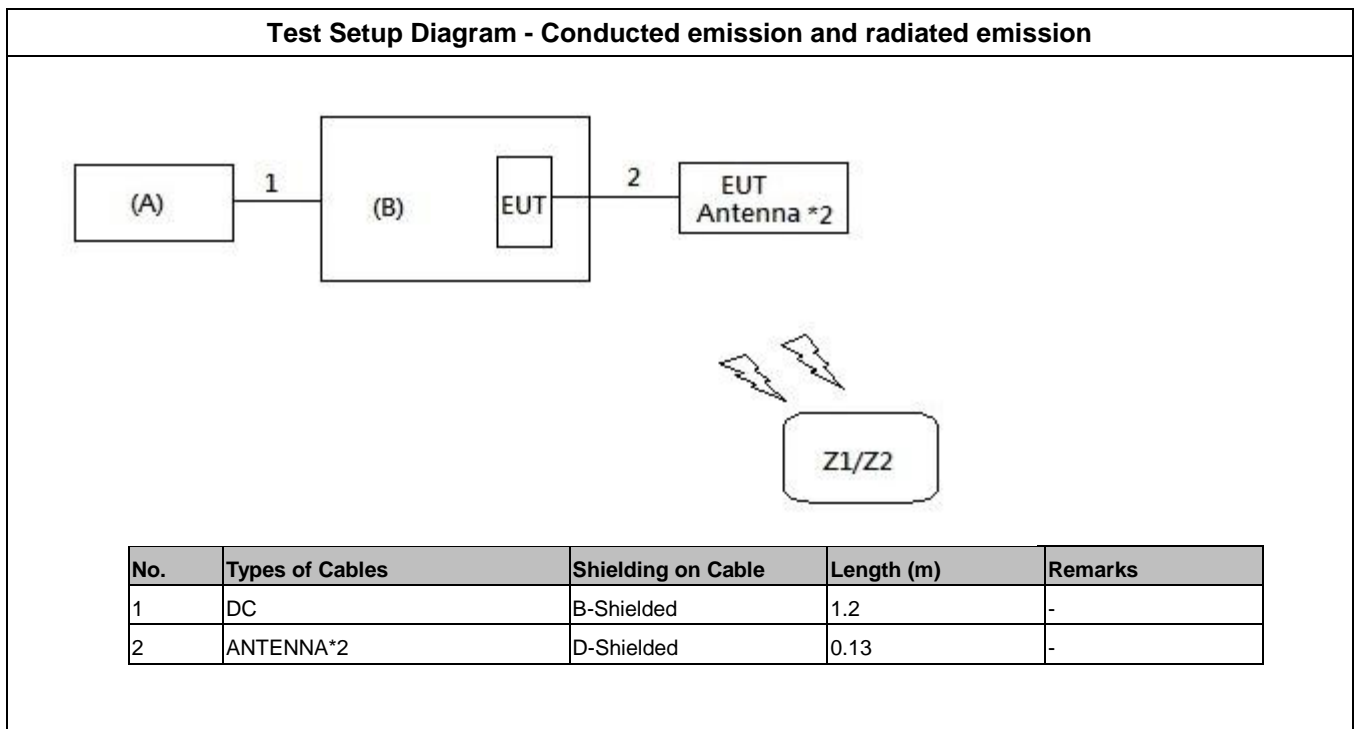
### Conducted emission and radiated emission

No.	Peripheral	Manufacturer	Model Number	FCC ID	Remarks
<b>For Local</b>					
A	Adapter	YINGHUIYUAN	YHY-12004000	DoC	-
B	PCB fixture	N/A	N/A	-	-
<b>For Remote</b>					
Z1	Laptop	DELL	Latitude E5520	DoC	-
Z2	Laptop	DELL	Latitude E5520	DoC	-

### EMS

No.	Peripheral	Manufacturer	Model Number	Signal Cable	Cable Type	Length (m)	Remarks
<b>For Local</b>							
A	ADAPTER	YINGHUIYUAN	YHY-12004000	DC Cable	Non-Shielded	1.2	-
B	PCB fixture	N/A	N/A	-	-	-	-
<b>For Remote</b>							
Z	Laptop1	DELL	E5520	-	-	-	-
Z	Laptop2	DELL	E5520	-	-	-	-

### 2.3. Connection Diagram of Test System





## **2.4. Details of EUT Test Setup**

### **EMI & EMS**

During the test, the following program under WIN 7 was executed:

- The remote Laptop executed "ping" to link with the EUT to maintain the connection by WIFI.

### 3. General Information of Test

#### 3.1. Test Facilities

Test Lab : Sporton International Inc. Hsinhua Laboratory								
<input checked="" type="checkbox"/>	Hsinhua (TAF: 3785)	ADD : No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)						
		TEL : 886-3-327-3456			FAX : 886-3-327-0973			
<input checked="" type="checkbox"/>		ADD : No.3, Ln. 238, Kangle St., Neihu Dist., Taipei City 114040, Taiwan (R.O.C.)						
		TEL : 886-2-2631-5551			FAX : 886-2-2631-9740			
Test Items		Test Site No.	Test Engineer	Test Environment			Test Date	Remark
				temp °C	humidity %	pressure kPa		
Powerline Conducted Emissions		CO01-NH	Willy Lee	23.6~23.7	71~72	-	11/Apr/2022	-
Radiated Emissions (below 1GHz)		OS03-NH	Louis Lin	24.1~24.2	63.1~63.2	-	11/Apr/2022	-
Radiated Emissions (above 1GHz)		03CH04-HY	Alan Chen	23.8~23.9	62~63	-	21/Apr/2022	-
ESD		ES01-HY	Jaily	22.1~22.9	48~49	100	16/Apr/2022	-
RS		RS01-HY	Jaily	23.6~23.9	47~48	100	16/Apr/2022	-

### 3.2. Test Standards

Applied Standards	ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09)
<b>Test items</b>	<b>Test Standards and Test Procedures</b>
Radiated and AC Conducted Emissions	European Standard EN 55032 Class B
Harmonics	European Standard EN 61000-3-2
Voltage Fluctuations	European Standard EN 61000-3-3
EMS	ESD: EN 61000-4-2, RS: EN 61000-4-3, EFT: EN 61000-4-4, SURGES: EN 61000-4-5, CS: EN 61000-4-6, DIP: EN IEC 61000-4-11
Note: All test items were verified and recorded according to the standards and without any deviation during the tests.	

### 3.3. Test Voltage/Frequencies

<b>Power Supply Type</b>	<b>Voltage/Frequencies</b>
Host System	230V / 50Hz

### 3.4. Test Distance and Frequency Range Investigated

<b>Test Items</b>	<b>Frequency Range</b>	<b>Remark</b>
Powerline Conducted Emissions	150 kHz to 30 MHz	-
Radiated Emissions (below 1GHz)	30 MHz to 1,000 MHz	Measurement distance is 10 m.
Radiated Emissions (above 1GHz)	1,000 MHz to 6,000 MHz	Measurement distance is 3 m.
Radio frequency electromagnetic field immunity	80 to 6,000 MHz	Measurement distance is 3 m.

### 3.5. Operating Condition

- Customers request this specification for test plan.



## 4. Emissions Measurement

The EUT is which satisfies the Class B disturbance limits.

### 4.1. Conducted Emissions at Powerline

#### 4.1.1. Limit

Limits for conducted disturbance at the mains ports of class A			
Frequency range MHz	Coupling device	Detector type / bandwidth	Class A limits dB(μV)
0,15 – 0,5	AMN	Quasi-peak / 9 kHz	79
0,50 – 30			73
0,15 – 0,5	AMN	Average / 9 kHz	66
0,50 – 30			60

Note 1: The lower limit shall apply at the transition frequency.

Limits for conducted disturbance at the mains ports of class B			
Frequency range MHz	Coupling device	Detector type / bandwidth	Class B limits dB(μV)
0,15 – 0,5	AMN	Quasi-peak / 9 kHz	66 - 56
0,5 – 5			56
5 – 30			60
0,15 – 0,5	AMN	Average / 9 kHz	56 - 46
0,5 – 5			46
5 – 30			50

Note 1: The lower limit shall apply at the transition frequencies.  
 Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

**4.1.2. Test Procedures****Tabletop equipment:**

- a). The EUT was warmed up for 15 minutes before testing started.
- b). The EUT was placed on a desk 0.8 meter 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 meter from any other grounded conducting surface.
- c). Connect EUT to the power mains through a line impedance stabilization network (LISN).
- d). All the support units are connect to the other LISN.
- e). The LISN provides 50 ohm, coupling impedance for the measuring instrument.
- f). The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
- g). Both sides of AC line were checked for maximum conducted interference.
- h). The frequency range from 150 kHz to 30 MHz was searched.
- i). Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- j). All emissions not reported here are more than 10 dB below the prescribed limit.

**Floor-standing equipment:**

- a). The EUT was warmed up for 15 minutes before testing started.
- b). The EUT was placed on the horizontal ground reference plane, 0.15 meter above ground.
- c). Connect EUT to the power mains through a line impedance stabilization network (LISN).
- d). All the support units are connect to the other LISN.
- e). The LISN provides 50 ohm, coupling impedance for the measuring instrument.
- f). The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
- g). Both sides of AC line were checked for maximum conducted interference.
- h). The frequency range from 150 kHz to 30 MHz was searched.
- i). Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- j). All emissions not reported here are more than 10 dB below the prescribed limit.

**4.1.3. Measurement Results Calculation**

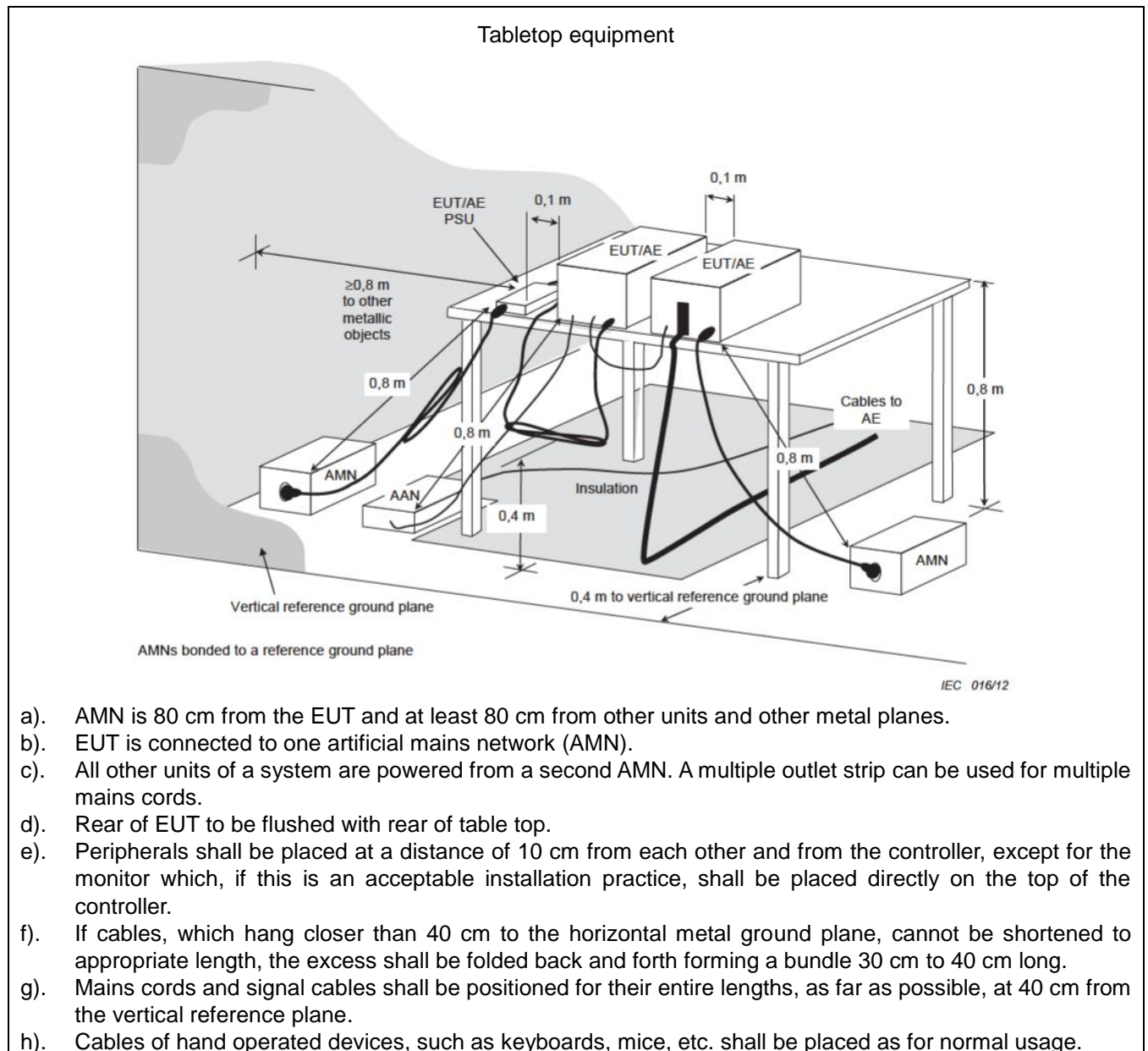
The measured Level is calculated using:

Corrected Reading (dB $\mu$ V) = LISN Factor + Cable Loss + Read Level

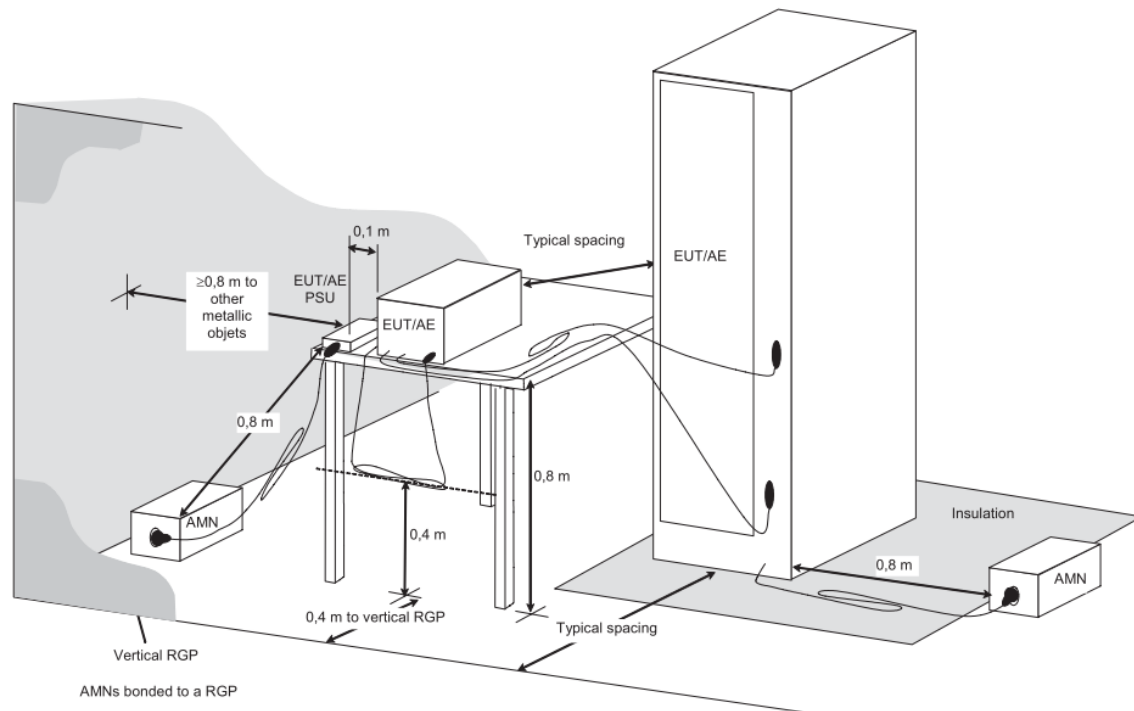
For example at 0.3 MHz if the LISN Factor is 10.48 dB, the cable loss is 0.10 dB, the measured voltage is 36.39 dB $\mu$ V, the signal strength would be calculated:

Corrected Reading (dB $\mu$ V) = 10.48 dB + 0.10 dB + 36.39 dB $\mu$ V = 46.97 dB $\mu$ V

## 4.1.4. Typical Test Setup Layout



Floor-standing equipment



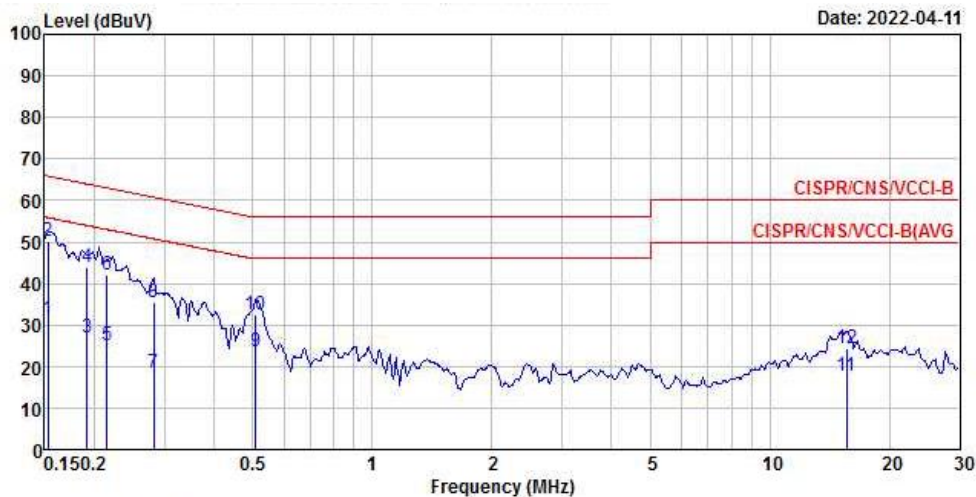
IEC 021/12

- AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
- EUT is connected to one artificial mains network (AMN)
- All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
- Rear of EUT to be flushed with rear of table top.
- Peripherals shall be placed at a distance of 10 cm from each other and from the controller, except for the monitor which, if this is an acceptable installation practice, shall be placed directly on the top of the controller.
- If cables, which hang closer than 40 cm to the horizontal metal ground plane, cannot be shortened to appropriate length, the excess shall be folded back and forth forming a bundle 30 cm to 40 cm long.
- Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
- Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.
- The EUT shall be insulated (by insulation of maximum thickness of 150 mm) from the horizontal reference ground plane.

## 4.1.5. Test Result

Test Mode	Mode 1		
Test Frequency	0.15 MHz ~ 30 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

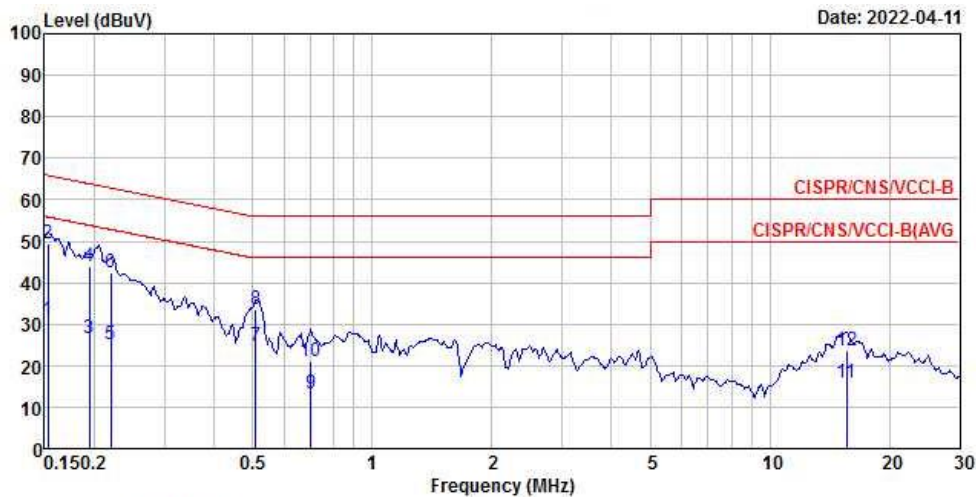
### Line



	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
			dB	dBuV	dBuV	dB	dB	
1	0.15	31.26	-24.56	55.82	20.89	10.28	0.09	Average
2 @	0.15	50.08	-15.74	65.82	39.71	10.28	0.09	QP
3	0.19	26.84	-27.11	53.95	16.48	10.27	0.09	Average
4	0.19	44.04	-19.91	63.95	33.68	10.27	0.09	QP
5	0.22	25.05	-27.95	53.00	14.69	10.27	0.09	Average
6	0.22	42.24	-20.76	63.00	31.88	10.27	0.09	QP
7	0.28	18.33	-32.43	50.76	7.97	10.27	0.09	Average
8	0.28	35.57	-25.19	60.76	25.21	10.27	0.09	QP
9	0.51	23.77	-22.23	46.00	13.39	10.27	0.11	Average
10	0.51	32.39	-23.61	56.00	22.01	10.27	0.11	QP
11	15.63	17.89	-32.11	50.00	7.00	10.57	0.32	Average
12	15.63	24.39	-35.61	60.00	13.50	10.57	0.32	QP



## Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.15	31.02	-24.80	55.82	20.69	10.24	0.09	Average
2 @	0.15	49.38	-16.44	65.82	39.05	10.24	0.09	QP
3	0.19	26.63	-27.22	53.85	16.31	10.23	0.09	Average
4	0.19	44.07	-19.78	63.85	33.75	10.23	0.09	QP
5	0.22	25.05	-27.78	52.83	14.73	10.23	0.09	Average
6	0.22	42.27	-20.56	62.83	31.95	10.23	0.09	QP
7	0.51	24.57	-21.43	46.00	14.23	10.23	0.11	Average
8	0.51	33.62	-22.38	56.00	23.28	10.23	0.11	QP
9	0.70	13.36	-32.64	46.00	3.00	10.24	0.12	Average
10	0.70	21.04	-34.96	56.00	10.68	10.24	0.12	QP
11	15.63	15.73	-34.27	50.00	4.85	10.56	0.32	Average
12	15.63	23.79	-36.21	60.00	12.91	10.56	0.32	QP

## 4.2. Radiated Emission below 1GHz

### 4.2.1.Limit

radiated emissions at frequencies up to 1 GHz for Class A equipment			
Frequency range MHz	Measurement		Class A limits dB(μV/m)
	Distance (m)	Detector type / bandwidth	OATS/SAC
30 – 230	10	Quasi Peak / 120 kHz	40
230 – 1000			47
30 – 230	3		50
230 – 1000			57

radiated emissions at frequencies up to 1 GHz for Class B equipment			
Frequency range MHz	Measurement		Class B limits dB(μV/m)
	Distance (m)	Detector type / bandwidth	OATS/SAC
30 – 230	10	Quasi Peak / 120 kHz	30
230 – 1000			37
30 – 230	3		40
230 – 1000			47

#### 4.2.2. Test Procedures

##### Tabletop equipment

- a). The EUT was placed on a rotatable table top 0.8 meter above ground.
- b). The EUT was set 10 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- c). The table was rotated 360 degrees to determine the position of the highest radiation.
- d). 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.
- e). For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f). Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g). If the emission level of the EUT in peak mode was 3 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 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- h). The central point of the EUT shall be positioned at the center of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna.
- i). If the EUT is having a Wireless modular, can choose to install the filter at the input connector of test-receiver system.

##### Floor-standing equipment:

- a). The EUT was placed on the horizontal ground reference plane, 0.15 meter above ground.
- b). The EUT was set 10 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- c). The table was rotated 360 degrees to determine the position of the highest radiation.
- d). 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.
- e). For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f). Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g). If the emission level of the EUT in peak mode was 3 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 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- h). The central point of the EUT 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 the calibration point of the antenna.
- i). If the EUT is having a Wireless modular, can choose to install the filter at the input connector of test-receiver system.

#### 4.2.3. Measurement Results Calculation

The measured Level is calculated using:

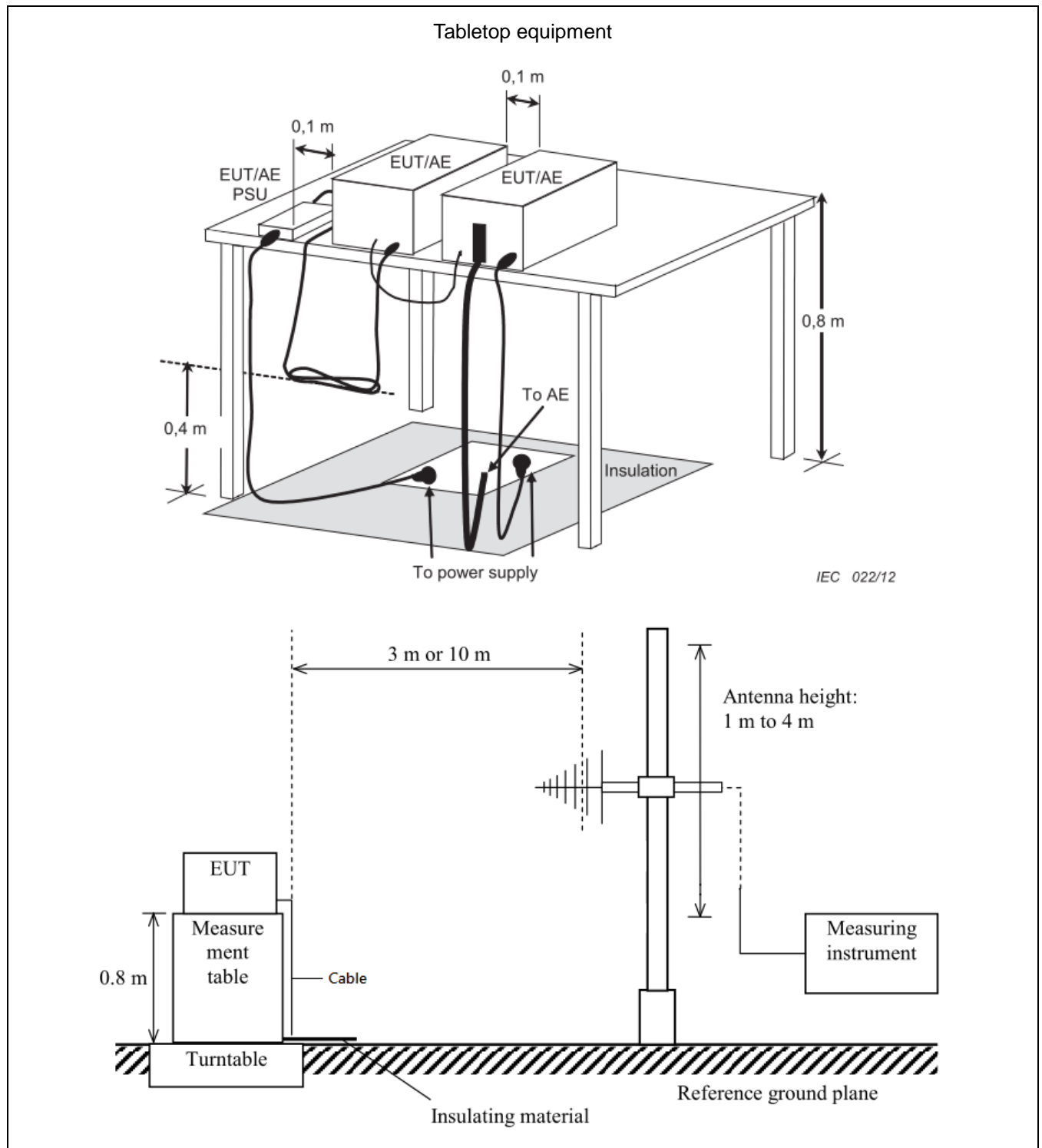
Corrected Reading (dB $\mu$ V/m) = Antenna Factor + Cable Loss + Read Level – Preamp Factor

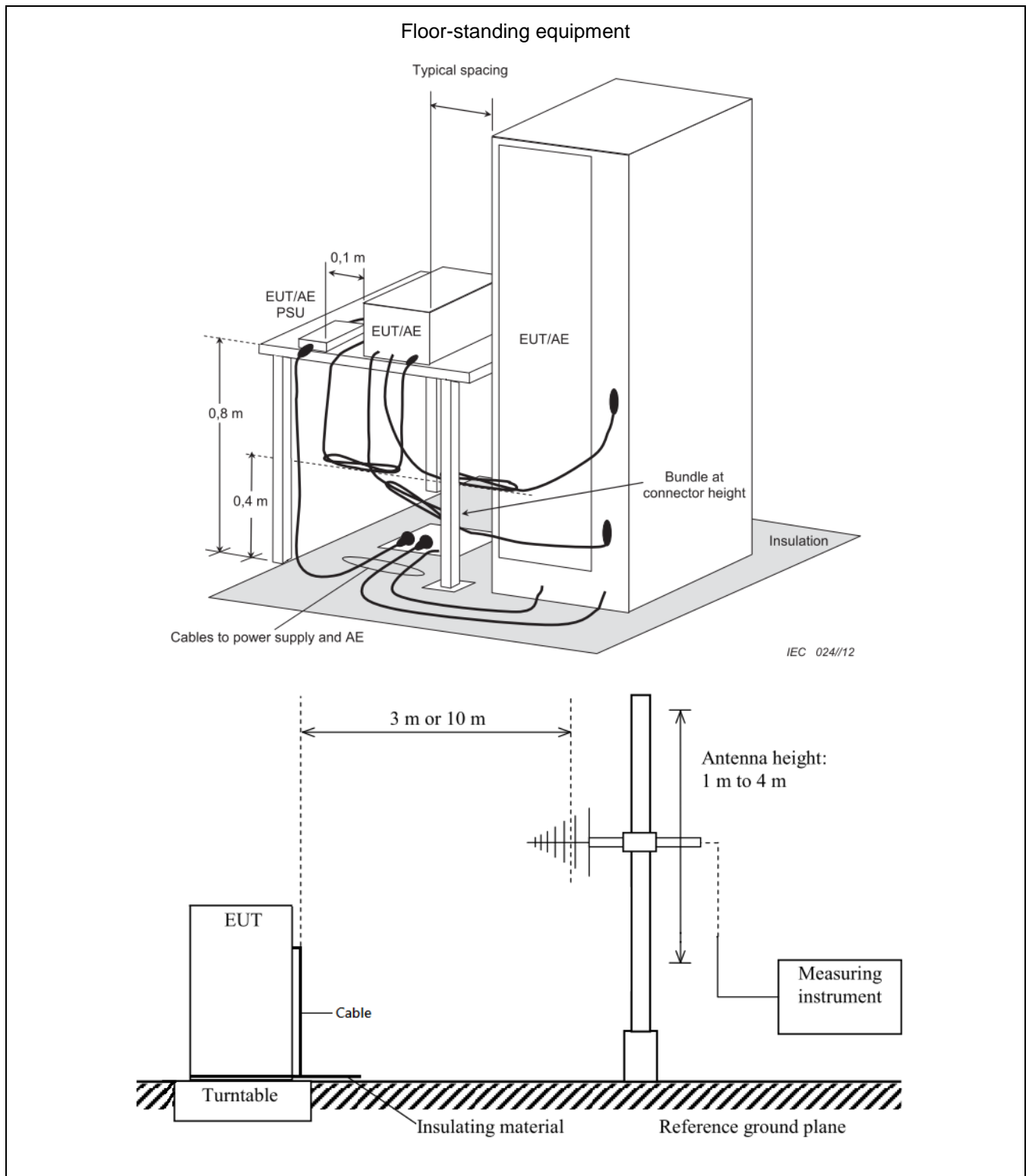
For example at 125 MHz if the Antenna Factor is 17.24 dB/m, the cable loss is 1.20 dB, the measured voltage is 35.80 dB $\mu$ V and the Preamp Factor is 27.18 dB, the signal strength would be calculated:

Corrected Reading (dB $\mu$ V/m) = 17.24 dB/m + 1.20 dB + 35.80 dB $\mu$ V - 27.18 dB = 27.06 dB $\mu$ V/m

Note: If a hybrid antenna is used, the antenna factor shall be the sum of the Antenna Factor + Attenuator Factor.

#### 4.2.4. Typical Test Setup Layout





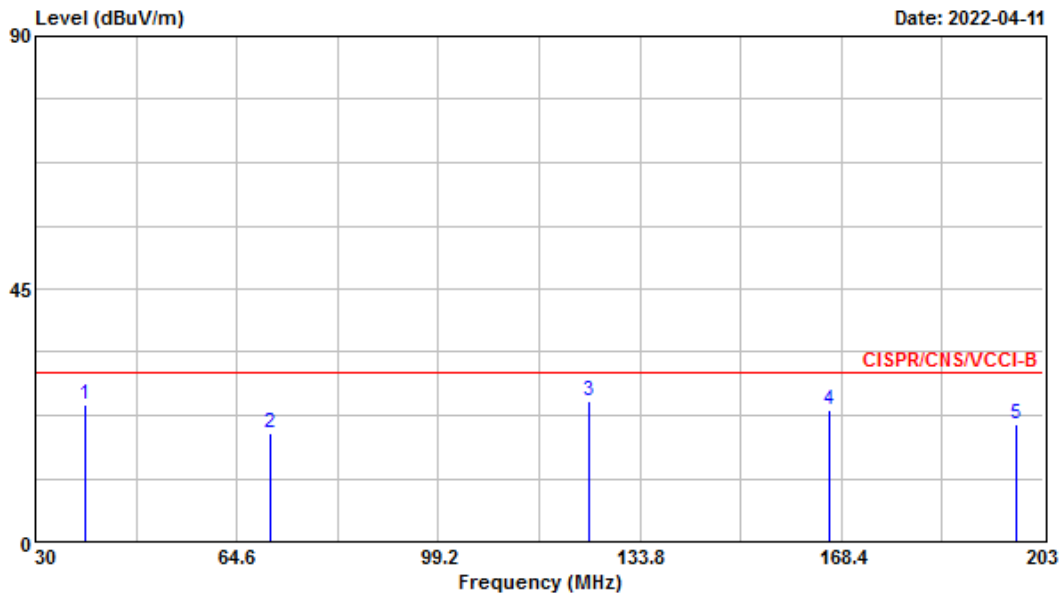




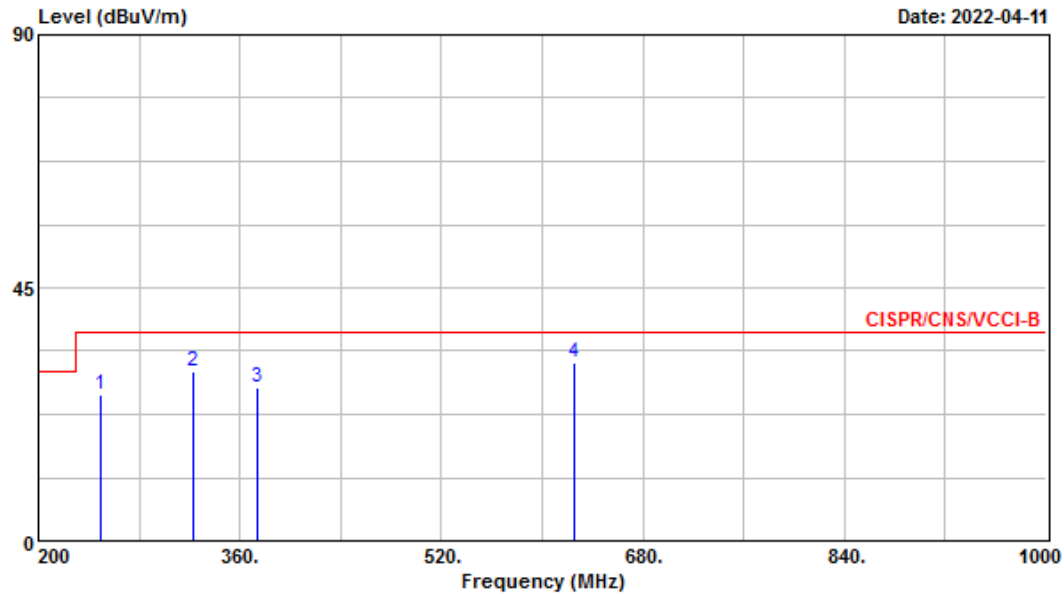
#### 4.2.5. Test Result

<b>Test mode</b>	Mode 1		
<b>Test frequency</b>	30 MHz ~ 1000 MHz	<b>Test Voltage</b>	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

#### Vertical

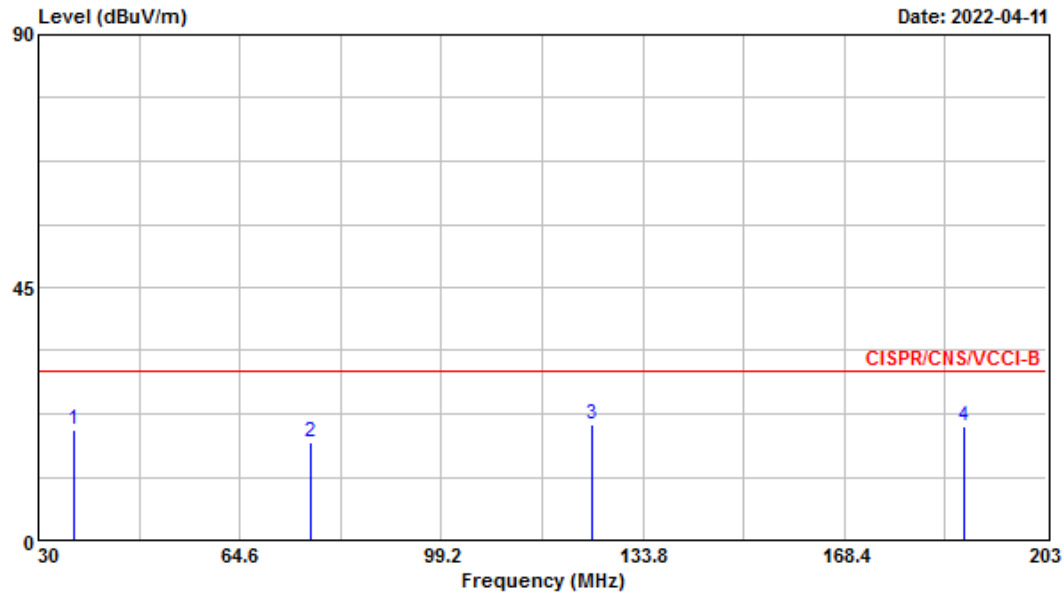


	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	38.480	24.37	-5.63	30.00	33.65	18.11	1.08	28.47	Peak	---	---
2	70.310	19.42	-10.58	30.00	34.77	11.56	1.52	28.43	Peak	---	---
3	125.150	25.11	-4.89	30.00	33.64	17.71	2.05	28.29	Peak	---	---
4	166.320	23.51	-6.49	30.00	34.27	14.97	2.43	28.16	Peak	---	---
5	198.330	21.05	-8.95	30.00	31.87	14.48	2.69	27.99	Peak	---	---

**Vertical**


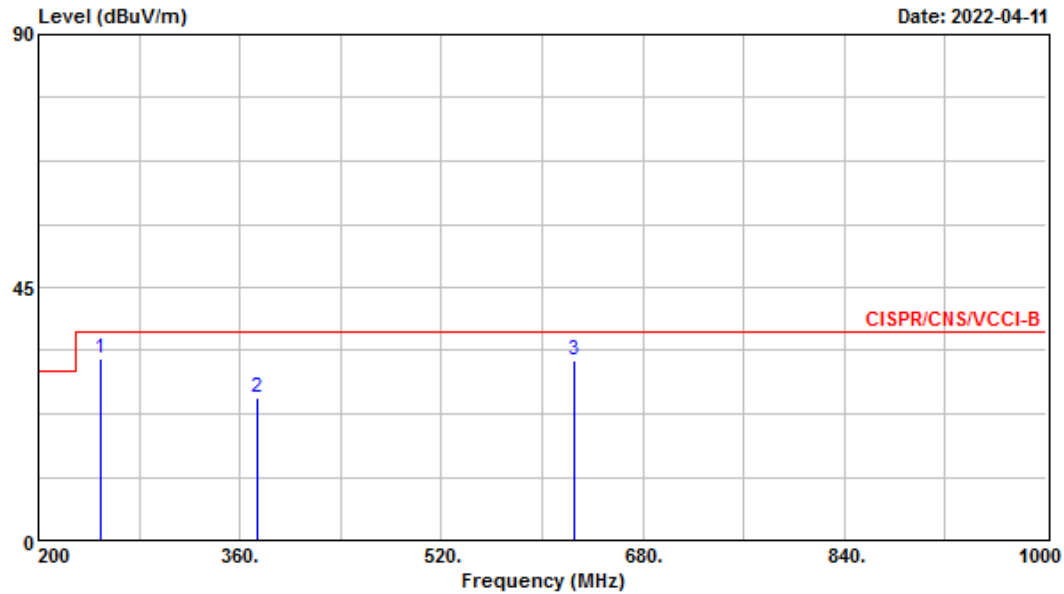
	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	249.600	25.87	-11.13	37.00	33.16	17.31	3.19	27.79	Peak	---	---
2	323.200	30.25	-6.75	37.00	35.77	18.82	3.62	27.96	Peak	---	---
3	374.400	27.41	-9.59	37.00	31.73	19.99	4.00	28.31	Peak	---	---
4	624.800	31.55	-5.45	37.00	31.38	23.89	5.45	29.17	Peak	---	---

## Horizontal



	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	36.060	19.57	-10.43	30.00	27.19	19.83	1.02	28.47	Peak	---	---
2	76.710	17.49	-12.51	30.00	32.54	11.74	1.63	28.42	Peak	---	---
3	125.150	20.52	-9.48	30.00	29.05	17.71	2.05	28.29	Peak	---	---
4	188.990	20.13	-9.87	30.00	31.15	14.44	2.59	28.05	Peak	---	---

## Horizontal



	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	249.600	32.44	-4.56	37.00	39.73	17.31	3.19	27.79	Peak	400	178
2	374.400	25.41	-11.59	37.00	29.73	19.99	4.00	28.31	Peak	---	---
3	624.800	31.88	-5.12	37.00	31.71	23.89	5.45	29.17	Peak	---	---

### 4.3. Radiated Emission above 1GHz

#### 4.3.1.Limit

radiated emissions at frequencies above 1 GHz for Class A equipment			
Frequency range MHz	Measurement		Class A limits dB(μV/m)
	Distance (m)	Detector type / bandwidth	SAC
1000 – 3000	3	Average / 1 MHz	56
3000 – 6000			60
1000 – 3000		Peak / 1 MHz	76
3000 – 6000			80

radiated emissions at frequencies above 1 GHz for Class B equipment			
Frequency range MHz	Measurement		Class B limits dB(μV/m)
	Distance (m)	Detector type / bandwidth	SAC
1000 – 3000	3	Average / 1 MHz	50
3000 – 6000			54
1000 – 3000		Peak / 1 MHz	70
3000 – 6000			74

Required highest frequency for radiated measurement	
Highest internal frequency ( $F_x$ )	Highest measured frequency
$F_x \leq 108 \text{ MHz}$	1 GHz
$108 \text{ MHz} < F_x \leq 500 \text{ MHz}$	2 GHz
$500 \text{ MHz} < F_x \leq 1 \text{ GHz}$	5 GHz
$F_x > 1 \text{ GHz}$	5 x $F_x$ up to a maximum of 6 GHz



**4.3.2. Test Procedures****Tabletop equipment:**

- a). Same test set up as below 1GHz radiated testing.
- b). The EUT was set 3 meter from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- c). There should be absorber placed between the EUT and Antenna and its located size should let the test site meet CISPR16-1-4 requirement.
- d). The table was rotated 360 degrees to determine the position of the highest radiation.
- e). The measured using a test-receiver system with both a peak and CISPR average detector.
- f). Set the DRG Horn Antenna at 1M height, then run the turn table to get the maximum noise reading from Horizontal and Vertical polarity separately the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g). When EUT locating on the turn-table, and its height is over 172cm (Antenna's 3dB beam width of 6GHz is 27°), the DRG Horn Antenna must be raised up and descended down, then turning around the turn-table to get the maximum noise reading of the Horizontal and Vertical polarity separately. Note the maximum raise up height is same as the top of EUT.
- h). If emission level of the EUT in peak mode was 23dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- i). The central point of the EUT shall be positioned at the center of the turntable. The measurement distance is the shortest horizontal distance between an imaginary circular periphery just encompassing this arrangement and the calibration point of the antenna.
- j). If the EUT is having a Wireless modular, can choose to install the filter at the input connector of test-receiver system.

**Floor-standing equipment:**

- a). Same test set up as below 1GHz radiated testing.
- b). The EUT was set 3 meter from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- c). There should be absorber placed between the EUT and Antenna and its located size should let the test site meet CISPR16-1-4 requirement.
- d). The table was rotated 360 degrees to determine the position of the highest radiation.
- e). The measured using a test-receiver system with both a peak and CISPR average detector.
- f). Set the DRG Horn Antenna at 1M height, then run the turn table to get the maximum noise reading from Horizontal and Vertical polarity separately the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g). When EUT locating on the turn-table, and its height is over 172cm (Antenna's 3dB beam width of 6GHz is 27°), the DRG Horn Antenna must be raised up and descended down, then turning around the turn-table to get the maximum noise reading of the Horizontal and Vertical polarity separately. Note the maximum raise up height is same as the top of EUT.
- h). If emission level of the EUT in peak mode was 23dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- i). The central point of the EUT 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 the calibration point of the antenna.
- j). If the EUT is having a Wireless modular, can choose to install the filter at the input connector of test-receiver system.

#### 4.3.3.Measurement Results Calculation

The measured Level is calculated using:

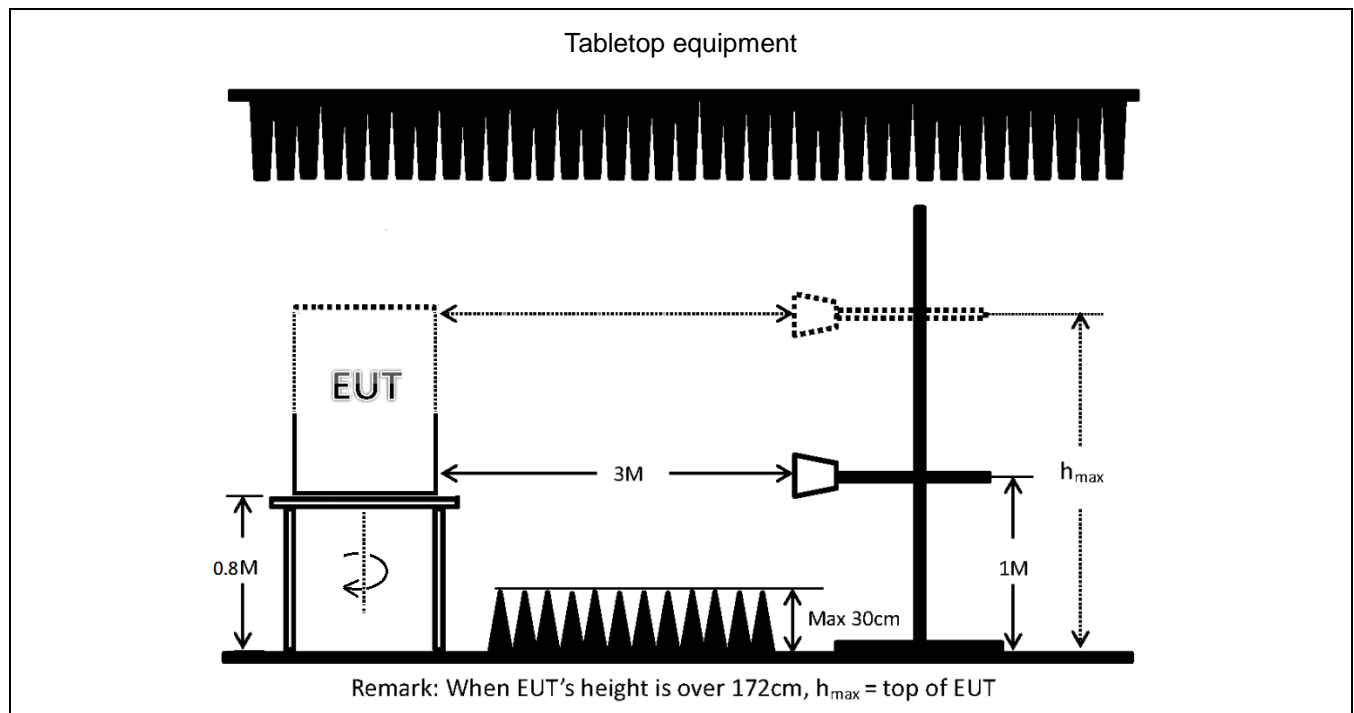
Corrected Reading (dB $\mu$ V/m) = Raw(Read Level)+AF(Antenna Factor)+CL(Cable Loss)-PA( Preamp Factor)

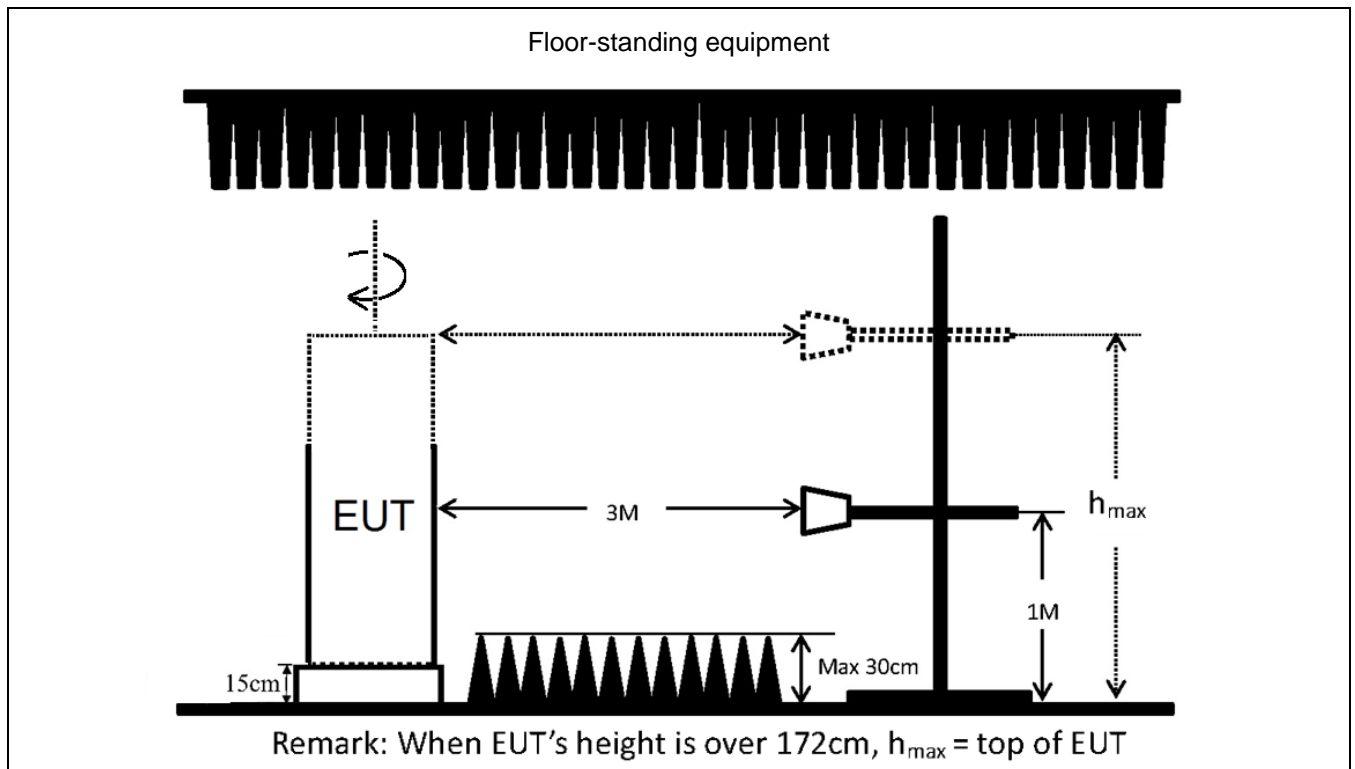
For example at 1980 MHz if the Antenna Factor is 26.19 dB/m, the cable loss is 4.08 dB, the measured voltage is 51.30 dB $\mu$ V and the Preamp Factor is 33.34 dB, the signal strength would be calculated:

Corrected Reading (dB $\mu$ V/m) = 51.30 dB $\mu$ V + 26.19 dB/m + 4.08 dB - 33.34 dB = 48.23 dB $\mu$ V/m

Note: If a Band reject filter is used, this factor will be added to the sum of the factors.

#### 4.3.4.Typical Test Setup Layout



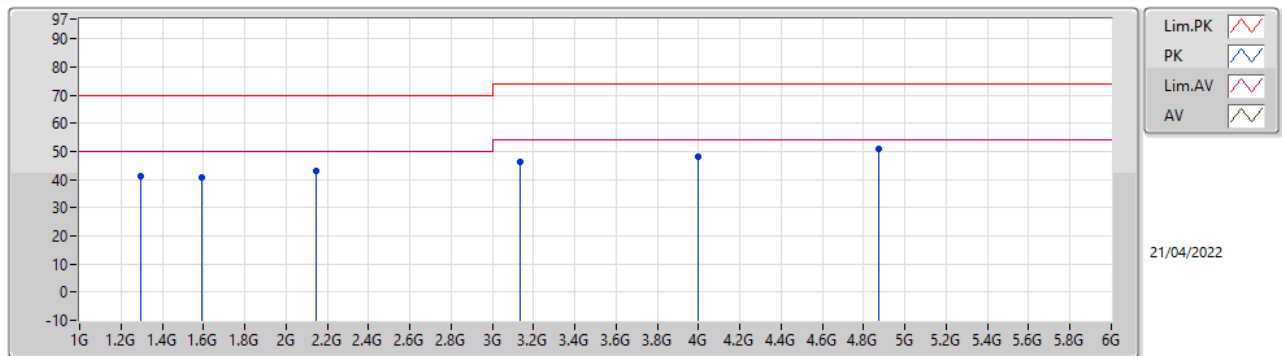


### 4.3.5. Test Result

Test mode	Mode 1		
Test frequency	1 GHz ~ 6 GHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

#### Vertical

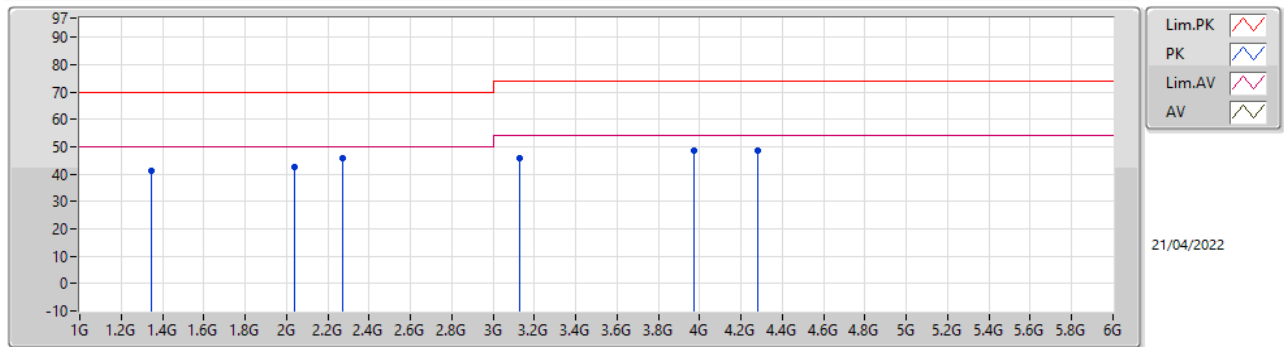
#### Mode 1



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB/m)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment	Raw (dBuV)	AF (dB/m)	CL (dB)	PA (dB)
PK	1.295G	41.10	70.00	-28.90	-5.19	3	Vertical	-	-	-	46.29	26.06	3.36	34.78
PK	1.595G	40.68	70.00	-29.32	-5.16	3	Vertical	-	-	-	45.84	25.31	3.72	34.40
PK	2.145G	43.01	70.00	-26.99	-1.89	3	Vertical	-	-	-	44.90	27.60	4.38	34.15
PK	3.135G	46.20	74.00	-27.80	1.23	3	Vertical	-	-	-	44.97	29.74	5.38	34.23
PK	4G	48.34	74.00	-25.66	3.91	3	Vertical	-	-	-	44.43	30.90	6.27	33.84
PK	4.875G	50.71	74.00	-23.29	6.06	3	Vertical	175	1	"Worst"	44.65	32.65	6.86	33.86

## Horizontal

### Mode 1



Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB/m)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comment	Raw (dBuV)	AF (dB/m)	CL (dB)	PA (dB)
PK	1.345G	41.04	70.00	-28.96	-4.75	3	Horizontal	-	-	-	45.79	26.37	3.41	34.70
PK	2.04G	42.56	70.00	-27.44	-2.60	3	Horizontal	-	-	-	45.16	26.98	4.29	34.13
PK	2.27G	45.66	70.00	-24.34	-2.27	3	Horizontal	100	1	"Worst"	47.93	27.12	4.47	34.16
PK	3.13G	45.98	74.00	-28.02	1.21	3	Horizontal	-	-	-	44.77	29.72	5.38	34.23
PK	3.97G	48.51	74.00	-25.49	3.88	3	Horizontal	-	-	-	44.63	30.96	6.25	33.85
PK	4.28G	48.47	74.00	-25.53	4.49	3	Horizontal	-	-	-	43.98	31.42	6.38	33.86

## 5. Performance Criteria of EUT for EN 301489 series

Performance criteria requirements table of 301 489-1	
<b>Performance criteria for continuous phenomena</b> During the test, the equipment shall: <ul style="list-style-type: none"> <li>• continue to operate as intended;</li> <li>• not unintentionally transmit;</li> <li>• not unintentionally change its operating state;</li> <li>• not unintentionally change critical stored data.</li> </ul>	
<b>Performance criteria for transient phenomena</b> For all ports and transient phenomena with the exception described below, the following applies: <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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:</li> <li>• 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.</li> <li>• 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.</li> </ul>	
For a 0 % residual voltage dip tests the following performance criteria apply: <ul style="list-style-type: none"> <li>• The performance criteria for transient phenomena shall apply (as specified in clause 6.2). For a 70 % residual voltage dip and voltage interruption tests, the following performance criteria apply:</li> <li>• in the case where the equipment is fitted with or connected to a battery back-up, the performance criteria for transient phenomena shall apply as specified in clause 6.2);</li> <li>• 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;</li> <li>• no unintentional responses shall occur at the end of the test, when the voltage is restored to nominal;</li> <li>• in the event of loss of function(s) or in the event of loss of user stored data, this fact shall be recorded.</li> </ul>	

<b>Performance criteria requirements table of 301 489-3</b>		
<b>Criteria</b>	<b>During test</b>	<b>After test</b>
<b>A</b>	Operate as intended No loss of function No unintentional responses	Operate as intended No loss of function No degradation of performance No loss of stored data or user programmable functions
<b>B</b>	May be loss of function No unintentional responses	Operate as intended Lost function(s) shall be self-recoverable No degradation of performance No loss of stored data or user programmable functions

For V2.1.2

Only the performance criteria specified in the present document or in ETSI EN 301 489-1 [1] where referenced shall apply.

The provisions of ETSI EN 301 489-1 [1], clause 6, shall apply together with the following.

<b>Performance criteria requirements table of 301 489-4</b>	
<b>The equipment shall meet the minimum performance criteria as specified in the following as appropriate.</b>	
Performance criterion for Continuous phenomena	
The provision of ETSI EN 301 489-1 [1], clause 6.1 shall apply with the following additions:	
<ul style="list-style-type: none"> <li>The communication link shall be maintained during and after the test.</li> <li>The specific performance criteria of clause 6.3, for continuous phenomena, shall additionally apply.</li> </ul>	
Performance criterion for Transient phenomena	
The provision of ETSI EN 301 489-1 [1], clause 6.2 shall apply with the following additions:	
<ul style="list-style-type: none"> <li>The communication link shall be maintained after the test.</li> <li>The specific performance criteria of clause 6.3, for transient phenomena, shall additionally apply.</li> </ul>	
Specific performance criteria	
The performance of the equipment shall be verified for digital signal ports:	
<ul style="list-style-type: none"> <li>by measuring the number of induced bit errors on the main signal port during the application of the continuous immunity phenomena;</li> <li>by testing the functionality of the main signal port and the other signal ports after the application of the immunity phenomena.</li> </ul>	



Performance criteria requirements table of 301 489-17 (Clause 6.2)		
Criteria	During test	After 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 the following requirements. 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 requirements table of 301 489-17(Clause 6.3 to 6.6)		
Criteria		
CT	The performance criteria A shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.	
CR	The performance criteria A shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.	
TT	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criteria C shall apply. Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.	
TR	The performance criteria B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criteria C shall apply. Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.	

Performance criteria requirements table of 301 489-19	
Criteria	
<b>A (CR)</b>	<p><b>Performance criteria for Continuous phenomena</b></p> <ul style="list-style-type: none"> <li>during the test no false calls shall occur;</li> <li>at the conclusion of the test comprising the series of individual exposures the EUT shall operate as intended with no loss of functions or stored data (messages), as declared by the manufacturer.</li> </ul> <p>During the test, the equipment shall operate as intended, e.g. not unintentionally change its operating state and not unintentionally change critical stored data.</p> <p>After the test, the equipment shall operate as intended, e.g. have no loss of function and have no loss of critical stored data.</p>
<b>B (TR)</b>	<p><b>Performance criteria for Transient phenomena</b></p> <ul style="list-style-type: none"> <li>during the test no false calls shall occur;</li> <li>at the conclusion of the test comprising the series of individual exposures, the EUT shall operate as intended with no loss of function and/or stored data (messages), as declared by the manufacturer.</li> </ul> <p>After the test, functions shall be self-recoverable and the equipment shall operate as intended and the equipment shall have no loss of critical stored data.</p>

Performance criteria requirements table of EN 301 489-33	
Criteria	The provision of ETSI EN 301 489-1 [1], clause 9 about performance criteria shall apply
<b>A (CT/CR)</b>	<p><b>Performance criteria for continuous phenomena applied to transmitters and receivers</b></p> <p>During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.</p> <p>During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.</p>
<b>B (TT/TR)</b>	<p><b>Performance criteria for transient phenomena applied to transmitters and receivers</b></p> <p>After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.</p> <p>During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.</p>

Performance criteria requirements table of EN 301 489-50			
Performance criteria for continuous phenomena			
Base Stations (BS)			
<b>UTRA</b>	Uplink and Downlink paths the observed BLER shall be less than $1 \times 10^{-2}$ and the BS shall operate as intended. The BLER calculation shall be based on evaluating the CRC on each transport block.		
<b>E-UTRA</b>	<b>E-UTRA Channel Bandwidth [MHz]</b>	<b>Bearer Information Data Rate</b>	<b>Performance Criteria (see note 3)</b>
	1,4	FRC A1-1 in clause A.1 in ETSI TS 136 104 [5]	Throughput > 95 %
	3	FRC A1-6 in clause A.1 in ETSI TS 136 104 [5] for E-UTRA with NB-IoT in-band operation	Throughput > 95 %
	5	FRC A1-7 in clause A.1 in ETSI TS 136 104 [5] for E-UTRA with NB-IoT in-band operation	Throughput > 95 %
	10	FRC A1-3 in clause A.1 in ETSI TS 136 104 [5] (see note 1)	Throughput > 95 %
	15	FRC A1-3 in clause A.1 in ETSI TS 136 104 [5] (see note 1)	Throughput > 95 %
	20	FRC A1-3 in clause A.1 in ETSI TS 136 104 [5] (see note 1) FRC A1-9 in clause A.1 in ETSI TS 136 104 [5] (see note 2)	Throughput > 95 %
NOTE 1: This is the information data rate of a single instance of the bearer mapped to 25 resource blocks. The performance criteria shall be met for each consecutive application of a single instance of the bearer mapped to disjoint frequency ranges with a width of 25 resource blocks each. This reference measurement channel is not applied for LAA Band 46. NOTE 2: This is the information data rate of a single instance of the bearer mapped to a single interlace. The performance criteria shall be met for each application of a single instance of the bearer mapped to each single interlace. This reference measurement channel is only applied for LAA Band 46. NOTE 3: Applies also if a bearer with another characteristic is used in the test.			
<b>NB-IoT</b>	<b>NB-IoT BS Performance criteria for continuous phenomena</b>		
	<b>NB-IoT Sub-carrier spacing [kHz]</b>	<b>Reference measurement channel</b>	<b>Performance Criteria (see note)</b>
	15	FRC A14-1 in clause A.14 in ETSI TS 136 104 [5]	Throughput > 95 %
	3,75	FRC A14-2 in clause A.14 in ETSI TS 136 104 [5]	Throughput > 95 %
NOTE: Applies also if a bearer with another characteristic is used in the test.			
<b>GSM /EDGE</b>	Downlink The BER of the downlink shall be assessed during the test according to one of the test methods of clause 5.5.1 in the present document. If the test method of clause 5.5.1.1 in the present document is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1,6 % during the test. NOTE 1: This BER is the upper limit in ETSI TS 145 008 [7], clause 8.2.4 for RXQUAL = 3. If the test method of clause 5.5.1.2 in the present document is used, the value of RXQUAL shall not exceed 3 during the test. At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained		

	<p>Uplink</p> <p>The BER of the uplink shall be assessed during the test according to one of the test methods of clause 5.5.2 in the present document.</p> <p>If the test method of clause 5.5.2.1 in the present document is used, the value of RXQUAL shall not exceed 3 during the test.</p> <p>If the test method of clause 5.5.2.2 in the present document is used, the measured BER of the class 2 bits of TCH/FS shall not exceed 1,6 % during the test.</p> <p>NOTE 2: This BER is the upper limit in ETSI TS 145 008 [7], clause 8.2.4 for RXQUAL = 3.</p> <p>For a base station the RXQUAL of the uplink shall not exceed three (3) measured during the test sequence.</p> <p>At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data, and the communication link shall have been maintained.</p>																																													
CDMA:	<p>The observed Frame Error Rate (FER) of the BS forward link and reverse link shall not exceed 1,0 % with 95 % confidence (see clause 6.8 in TIA-97 [18]).</p> <p>In the case of PAMR base stations the observed Frame Error Rate (FER) of the BS forward link and reverse link shall not exceed 2,0 % with 95 % confidence (see clause 6.8 in TIA-97 [18]).</p> <p>The test shall be performed using one or more bearers with the characteristics of data rate and throughput as stated in table 4, they should be representative of the EUTs intended use.</p> <table><tr><th>Mobile OFDMA WMAN Channel Bandwidth [MHz]</th><th>Performance Criteria (see note)</th></tr><tr><td>5</td><td>Throughput &gt; 95 %</td></tr><tr><td>10</td><td>Throughput &gt; 95 %</td></tr><tr><td colspan="2">NOTE: Applies also if a bearer with another characteristics is used in the test.</td></tr></table>	Mobile OFDMA WMAN Channel Bandwidth [MHz]	Performance Criteria (see note)	5	Throughput > 95 %	10	Throughput > 95 %	NOTE: Applies also if a bearer with another characteristics is used in the test.																																						
Mobile OFDMA WMAN Channel Bandwidth [MHz]	Performance Criteria (see note)																																													
5	Throughput > 95 %																																													
10	Throughput > 95 %																																													
NOTE: Applies also if a bearer with another characteristics is used in the test.																																														
NR	<p><b>FR1 performance criteria for continuous phenomena</b></p> <table><tr><th>NR channel bandwidth [MHz]</th><th>Sub-carrier spacing [kHz]</th><th>Bearer information data rate</th><th>Performance criteria (see note)</th></tr><tr><td>5, 10, 15</td><td>15</td><td>G-FR1-A1-1 in clause A.1 in ETSI TS 138 104 [20]</td><td rowspan="6">Throughput &gt; 95 %</td></tr><tr><td>10, 15</td><td>30</td><td>G-FR1-A1-2 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td>10, 15</td><td>60</td><td>G-FR1-A1-3 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td>20, 25, 30, 40, 50</td><td>15</td><td>G-FR1-A1-4 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td>20, 25, 30, 40, 50, 60, 70, 80, 90, 100</td><td>30</td><td>G-FR1-A1-5 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td>20, 25, 30, 40, 50, 60, 70, 80, 90, 100</td><td>60</td><td>G-FR1-A1-6 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td colspan="4">NOTE: Applies also if a bearer with another characteristics is used in the test.</td></tr><p><b>FR2 performance criteria for continuous phenomena</b></p><table><tr><th>NR channel bandwidth [MHz]</th><th>Sub-carrier spacing [kHz]</th><th>Bearer information data rate</th><th>Performance criteria (see note)</th></tr><tr><td>50, 100, 200</td><td>60</td><td>G-FR2-A1-1 in clause A.1 in ETSI TS 138 104 [20]</td><td rowspan="3">Throughput &gt; 95 %, no loss of service</td></tr><tr><td>50</td><td>120</td><td>G-FR2-A1-2 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td>100, 200, 400</td><td>120</td><td>G-FR2-A1-3 in clause A.1 in ETSI TS 138 104 [20]</td></tr><tr><td colspan="4">NOTE: Applies also if a bearer with another characteristics is used in the test.</td></tr></table></table>	NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (see note)	5, 10, 15	15	G-FR1-A1-1 in clause A.1 in ETSI TS 138 104 [20]	Throughput > 95 %	10, 15	30	G-FR1-A1-2 in clause A.1 in ETSI TS 138 104 [20]	10, 15	60	G-FR1-A1-3 in clause A.1 in ETSI TS 138 104 [20]	20, 25, 30, 40, 50	15	G-FR1-A1-4 in clause A.1 in ETSI TS 138 104 [20]	20, 25, 30, 40, 50, 60, 70, 80, 90, 100	30	G-FR1-A1-5 in clause A.1 in ETSI TS 138 104 [20]	20, 25, 30, 40, 50, 60, 70, 80, 90, 100	60	G-FR1-A1-6 in clause A.1 in ETSI TS 138 104 [20]	NOTE: Applies also if a bearer with another characteristics is used in the test.				NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (see note)	50, 100, 200	60	G-FR2-A1-1 in clause A.1 in ETSI TS 138 104 [20]	Throughput > 95 %, no loss of service	50	120	G-FR2-A1-2 in clause A.1 in ETSI TS 138 104 [20]	100, 200, 400	120	G-FR2-A1-3 in clause A.1 in ETSI TS 138 104 [20]	NOTE: Applies also if a bearer with another characteristics is used in the test.			
NR channel bandwidth [MHz]	Sub-carrier spacing [kHz]	Bearer information data rate	Performance criteria (see note)																																											
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100, 200, 400	120	G-FR2-A1-3 in clause A.1 in ETSI TS 138 104 [20]																																												
NOTE: Applies also if a bearer with another characteristics is used in the test.																																														
Repeaters	<p>The RF gain of the EUT shall be measured throughout the period of exposure to the phenomenon. The RF gain measured during the test shall not deviate from the gain measured before the test by more than ±1 dB. At the conclusion of the test the EUT shall operate as intended with no loss of user control functions or stored data.</p>																																													

**Performance criteria for transient phenomena**

The provision of ETSI EN 301 489-1 [1], clause 6.2 shall apply.

**Repeaters**

The RF gain of the EUT shall be measured before the test and after each exposure.  
At the conclusion of each exposure the gain of the EUT shall not have changed by more than  $\pm 1$  dB.  
At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended with no loss of user control functions or stored data, and the gain of the EUT shall not have changed by more than  $\pm 1$  dB.

<b>Performance criteria requirements table of EN 301 489-52</b>	
<b>GSM</b>	<p><b>Performance criteria for Continuous phenomena applied to Transmitters</b></p> <p>During the test, the uplink speech output level shall be at least 35 dB (<math>\pm 3</math> dB) less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centered on 1 kHz (audio breakthrough check).</p> <p>NOTE: When there is a high-level background noise present, the filter bandwidth can be reduced down to a minimum of 40 Hz.</p> <p>At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communication link shall have been maintained. In addition to confirming the above performance during a call, the test shall also be performed in idle mode, and the transmitter shall not unintentionally operate.</p>
	<p><b>Performance criteria for Continuous phenomena applied to Receivers</b></p> <p>During the test, the RXQUAL of the downlink shall not exceed the value of three, measured during each individual exposure in the test sequence. During the test, the downlink speech output level shall be at least 35 dB (<math>\pm 3</math> dB) less than the previously recorded reference levels, when measured through an audio band pass filter of width 200 Hz, centered on 1 kHz (audio breakthrough check).</p> <p>NOTE: When there is a high-level background noise present, the filter bandwidth can be reduced down to a minimum of 40 Hz.</p> <p>At the conclusion of the test, the EUT shall operate as intended with no loss of user control functions or critical stored data, and the communication link shall have been maintained.</p>
<b>UTRA</b>	<ul style="list-style-type: none"> <li>• if the BER (as referred in clause 5.3.1 of ETSI TS 134 109 [4]) is used, it shall not exceed 0,001 during the test sequence;</li> <li>• if the BLER (as referred in ETSI TS 134 109 [4]) is used, it shall not exceed 0,01 during the test sequence. The BLER calculation shall be based on evaluating the CRC on each transport block.</li> </ul>
<b>E-UTRA, E-UTRA with LAA, inband or guard band NB-IoT, Standalone NB-IoT/NR</b>	
In data transfer mode, the data throughput of the EUT shall not fall below 95 % of the maximum data throughput	
<b>Performance criteria for Transient phenomena</b>	
<p>At the conclusion of each exposure of the transient phenomena, the EUT shall operate without loss of the communication link. At the conclusion of the total test comprising the series of individual exposures, the EUT shall operate as intended without loss of user control functions or critical stored data.</p> <p>In addition where the EUT supports idle mode it should be verified that the transmitter shall not unintentionally operate when transient phenomena are applied.</p>	

## 6. Immunity Measurement

### 6.1. Electrostatic Discharge (ESD)

#### 6.1.1. Test Specification

<b>Reference Standard</b>	EN 61000-4-2
<b>Discharge Impedance</b>	330 $\Omega$ / 150 pF
<b>Polarity</b>	Positive and negative
<b>Single Discharge Mode</b>	1 discharge per 1s

#### 6.1.2. Test Levels

Contact discharge		Air Discharge	
Level	Test Voltage kV	Level	Test Voltage kV
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
x	Specified	x	Specified

Remark : "x" can be any level, above, below or in between the others. The level shall be specified in the dedicated equipment specification. If higher voltages than those shown are specified, special test equipment may be needed.

#### 6.1.3. Performance Criteria

Test Discharge	Discharge Test Voltage (kV)	Performance Criteria
Contact Discharges	$\pm 2 / \pm 4$	B
Air Discharge	$\pm 2 / \pm 4 / \pm 8$	B



#### 6.1.4. Test Procedure

- 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. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.
- e. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.
- f. 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.
- g. 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.

#### 6.1.5. Test Setup for Tests Performed in Laboratory

A ground reference plane was provided on the floor of the test site. It was a metallic sheet (copper or aluminum) of 0.25 mm, minimum thickness; other metallic may be used but they shall have at least 0.65 mm thickness. In the Hsinhua LAB., we provided 1 mm thickness aluminum ground reference plane or 1 mm thickness stainless steel ground reference plane. The minimum size of the ground reference plane is 1 m x 1 m, the exact size depending on the dimensions of the EUT. It was connected to the protective grounding system.

The EUT was arranged and connected according to its functional requirements. A distance of 1 m minimum was provided between the EUT and the wall of the Lab., and any other metallic structure. In cases where this length exceeds the length necessary to apply the discharges to the selected points, the excess length shall, where possible, be placed non-inductively off the ground reference plane and shall not come closer than 0.2 m to other conductive parts in the test setup.

##### Tabletop equipment:

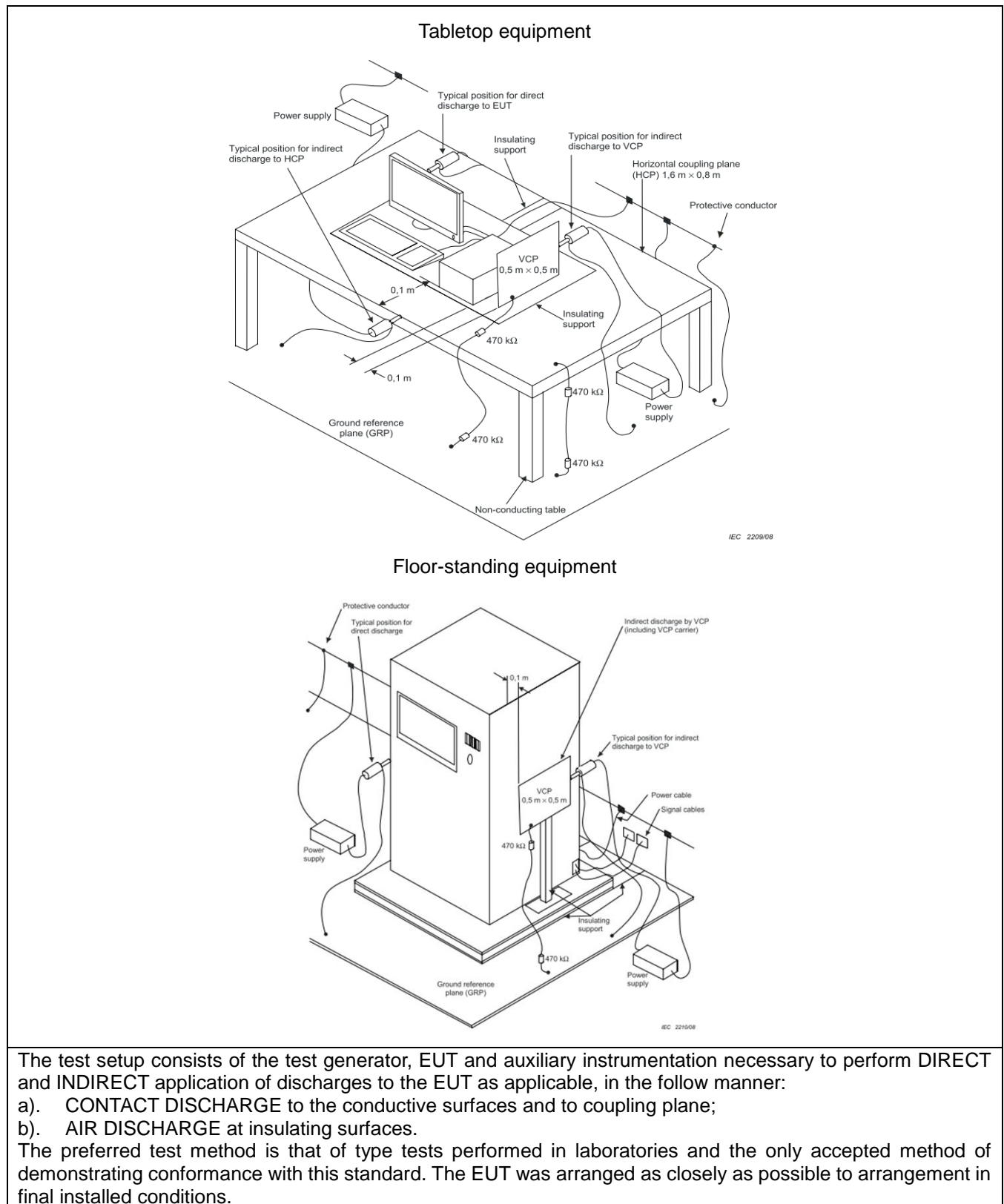
Where the EUT is installed on a metal table, the table was connected to the reference plane via a cable with a 470k ohm resistor located at each end, to prevent a build-up of charge. The test setup was consist a wooden table, 0.8 m high, standing on the ground reference plane. A HCP, 1.6 m x 0.8 m, was placed on the table. The EUT and cables was isolated from the HCP by an insulating support 0.5 mm thick. The VCP size, 0.5 m x 0.5 m.

##### Floor-standing equipment:

The EUT shall be isolated from the ground reference plane by an insulating support of 0,05 m to 0,15 m thick. The EUT cables shall be isolated from the ground reference plane by an insulating support of (0,5 ± 0,05) mm. This cable isolation shall extend beyond the edge of the EUT isolation.

The VCP size, 0.5 m x 0.5 m

## 6.1.6. Test Setup



**6.1.7. Test Result**

<b>Test mode</b>	Mode 1
<b>Applicable Standard</b>	ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09)
<b>Final Test Result</b>	<b>PASS</b>
<b>Contact discharge</b>	±4 kV
<b>Air discharge</b>	±8 kV
<b>Performance Criteria</b>	B

**Test Result - Air Discharge/Round Tip**

Those points and surfaces of equipment which are no longer accessible after fixed installation or after following the instructions for use.

**Test Result - Contact Discharge/Pointed Tip**
**Direct discharge**

No direct discharge

**Indirect discharge to HCP and VCP**

Test Point	No. of Disch.	Test Result (Criteria)		Remark
		+4kV	-4kV	
HCP (At Front)	10	A	A	-
HCP (At Left)	10	A	A	-
HCP (At Right)	10	A	A	-
HCP (At Rear)	10	A	A	-
VCP (At Front)	10	A	A	-
VCP (At Left)	10	A	A	-
VCP (At Right)	10	A	A	-
VCP (At Rear)	10	A	A	-



**Test Result - Packet error ratio(PER)**

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

**Test result PER=0%, less than 10% (Wi-Fi 2.4G)**

```
Reply from 192.168.1.1: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 800, Received = 800, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 58ms, Average = 4ms
```

**Test result PER=0%, less than 10% (Wi-Fi 5G)**

```
Reply from 192.168.1.1: bytes=32 time=3ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 840, Received = 840, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1265ms, Average = 4ms
```

## 6.2. Radio Frequency Electromagnetic Field (RS)

### 6.2.1. Test Specification

<b>Reference Standard</b>	EN 61000-4-3
<b>Dwell Time</b>	2.9 seconds
<b>Frequency Step size</b>	1 % of the preceding frequency value
<b>Antenna Polarity</b>	Vertical and Horizontal

### 6.2.2. Test Levels

<b>Level</b>	<b>Test field strength V/m</b>
1	1
2	3
3	10
4	30
x	Specified
Remark : "x" is an open test level and the associated field strength may be any value. This level may be given in the product standard.	

### 6.2.3. Performance Criteria

<b>Frequency Range</b>	<b>Test Field Strength (V/m)</b>	<b>Performance Criteria</b>
80 MHz to 6000 MHz	3	A

#### **6.2.4.RF Exclusion Band of Radio Equipment**

##### **EN 301 489-1**

###### **a. General**

Exclusion bands shall not be applied when measuring transmitters in standby mode.

###### **b. Channelized Equipment**

For channelized equipment the exclusion band shall extend 250% of the channel width either side of the transmitter center frequency.

NOTE: Exclusion band of 250 % is based on the ITU Radio Regulations, as the boundary between OOB and Spurious Domain.

###### **c. Non-Channelized Equipment**

For non-channelized equipment the exclusion band shall extend 250% of the occupied bandwidth either side of the transmitter center frequency.

NOTE: Exclusion band of 250 % is based on the ITU Radio Regulations, as the boundary between OOB and Spurious Domain.

#### **Exclusion band for receivers or the receiver part of transceivers**

###### **a. Applicability**

Exclusion bands are not applied when testing emissions of receivers or receiver part of transceivers.

###### **b. Channelized Equipment**

For channelized equipment the exclusion band shall be calculated by using the following formulae:

For the lower edge for the exclusion band:

$$\text{EXband(lower)} = \text{BandRX(lower)} - n\text{ChWRX}$$

and for the upper edge of the exclusion band:-

$$\text{EXband(upper)} = \text{BandRX(upper)} + n\text{ChWRX}$$

Where n = number of channel widths required for exclusion band

For equipment that support multiple channel widths the Channel Width used should be the widest support by the EUT.

Where the present document is being used in a stand-alone basis (i.e. with no reference to other relevant radio technology parts of ETSI EN 301 489 series), the value of n shall be 1.

###### **c. Non-Channelised Equipment**

For non-channelized equipment the exclusion band shall be calculated by using the following formula:

For the lower edge for the exclusion band:

$$\text{EXband(lower)} = \text{BandRX(lower)} - n\text{BWRX}$$

and for the upper edge of the exclusion band:-

$$\text{EXband(upper)} = \text{BandRX(upper)} + n\text{BWRX}$$

Where n = multiple of whole bandwidths required to define exclusion band

Bandwidth of Receiver is the occupied bandwidth of the corresponding transmitter signal.

Where the present document is being used in a stand-alone basis (i.e. with no reference to other relevant radio technology parts of ETSI EN 301 489 series), the value of n shall be 1.

**EN 301 489-3**
**Exclusion bands for emissions testing**
**Transmitters**

The exclusion band shall be those frequencies specified in the relevant radio standard as the operating frequency band and the Out of Band domain.

Where this is not so specified the exclusions bands shall be as below:

- For transmitters operating, or intended to operate, in a channelized frequency band, the exclusion band is five times (i.e.  $\pm 250\%$ ) the maximum operating channel width (OCW) allowed for that service, centred around the operating frequency.
- For wide band transmitters, i.e. transmitters in a non-channelized frequency band, the exclusion band is twice the intended operating frequency band centred around the center frequency of the intended operating frequency band.

The exclusion band shall only apply when the EUT is in transmit mode of operation.

**Exclusion bands for immunity testing**
**a. Transmitters**

Same as Exclusion bands for emissions testing

**b. Receivers**

The exclusion band is based on an extension value.

The lower limit of the exclusion band is the lower edge of the Operating Channel (OC) minus the extension value, or zero, whichever is the greater.

The upper limit is the upper edge of the OC plus the extension value.

The extension value is given in table 1. The OC is defined in the relevant radio standard.

Receiver operating Frequency $f_0$	Extension value
< 300 kHz	300 kHz
300 kHz to < 30 MHz	3 MHz
30 MHz to < 1 GHz	15 MHz, or $5\% \times f_0$ , whichever is greater
1 GHz to < 6 GHz	100 MHz
$\geq 6$ GHz	$5\% \times f_0$

NOTE: The receiver exclusion band frequency range aligns as far as possible with the blocking test frequency range defined in ETSI EN 300 220-1 [2]

For V2.1.2

The exclusion band is based on the lower edge (FOC<sub>low</sub>) and the upper edge (FOC<sub>high</sub>) and the centre ( $f_0$ ) of the Operating Channel (OC).

Where the OC is defined in the applicable harmonised radio standard, the values for that shall be used and  $f_0$  shall be the centre of the OC. In all other cases,  $f_0$  shall be the receiver operating frequency and the OC shall be  $\pm 0,05\%$  around  $f_0$

**Lower limit of exclusion band**

Lower edge of OC, FOC <sub>low</sub>	Lower limit of exclusion band
< 3 MHz	0
3 MHz to < 30 MHz	FOC <sub>low</sub> - 3 MHz
30 MHz to < 42 MHz	27 MHz
42 MHz to < 1 GHz	FOC <sub>low</sub> - 15 MHz, or FOC <sub>low</sub> - $0,05 \times f_0$ , whichever is lower
1 GHz to < 1,05 GHz	950 MHz
1,05 GHz to < 6 GHz	FOC <sub>low</sub> - 100 MHz
6 GHz to < 6,3 GHz	5,9 GHz
6,3 GHz	FOC <sub>low</sub> - $0,05 \times f_0$

Upper limit of exclusion band

Upper edge of OC, $FOC_{high}$	Upper limit of exclusion band
< 300 kHz	$FOC_{high} + 300 \text{ kHz}$
300 kHz to < 30 MHz	$FOC_{high} + 3 \text{ MHz}$
30 MHz to < 42 MHz	$FOC_{high} + 5 \text{ MHz}$
42 MHz to < 1 GHz	$FOC_{high} + 15 \text{ MHz}$ , or $FOC_{high} + 0,05 \times f_0$ , whichever is higher
1 GHz to < 6 GHz	$FOC_{high} + 100 \text{ MHz}$
6 GHz	$FOC_{high} + 0,05 \times f_0$

**C. Duplex and multi-mode equipment**

In the case of EUT tested with a simultaneous transmit and receive mode, the exclusion band used shall be the combination of the exclusion band for the transmitter and the exclusion band for the receiver. I.e. both exclusion bands shall be applied.

In the case of transmitters capable of operating on more than one frequency band, testing shall be carried out on each band separately.

In the case of receivers operating on more than one frequency, the exclusion band used shall be the combination of the exclusion bands for each frequency, i.e. an exclusion band for each frequency shall be applied.

NOTE: Where the frequencies are in the same operational frequency band, the result will usually be an enlarged single exclusion band. Where the frequencies are widely spaced, e.g. in different bands, the result will be to create multiple separate exclusion bands.

**EN 301 489-4**

**Exclusion bands for receivers**

For the lower edge for the exclusion band:

$$EX_{band(lower)} = \text{Band RX (lower)} - nChW_{RX}$$

and for the upper edge of the exclusion band:

$$EX_{band(upper)} = \text{Band RX (upper)} + nChW_{RX}$$

For equipment within the scope of the present document  $n=1$  and  $ChW_{RX}$  is the widest channel size as specified in ETSI

EN 302 217-2 [i.5] for the intended frequency band of the EUT.

For EUT that operate above 6 GHz there is no exclusion band specified as test ranges stop at 6 GHz.

**Exclusion bands for transmitters**

The provisions of ETSI EN 301 489-1 [1], clause 4.3.2 shall apply.



### EN 301 489-17

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. 2 603,5 MHz.

NOTE: This is based upon a channel size of 40 MHz and a value of  $n = 3$  from ETSI EN 301 489-1 [1], clause 4.3.3.

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 -320 MHz, i.e. 4 830 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 both the 5470 MHz - 5725 MHz and 5725 MHz - 5850 MHz bands. Therefore the test stops at the lower limit of exclusion band (i.e. 4 830 MHz).

NOTE: This is based upon a channel size of 80 MHz and a value of  $n = 4$  from ETSI EN 301 489-1 [1], clause 4.3.3.

The exclusion band for immunity testing of Broadband data transmitting systems operating in the 5,8 GHz band shall be:

- lower limit of exclusion band = lowest allocated band edge frequency -440 MHz, i.e. 5 285 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. Therefore the test stops at the lower limit of exclusion band (i.e. 5 285 MHz).

NOTE: This is based upon a channel size of 40 MHz and a value of  $n = 11$  from ETSI EN 301 489-1 [1], clause 4.3.3.

### EN 301 489-19

System	Frequency Band	RX Exclusion Band	
		Lower limit of exclusion band	Upper limit of exclusion band
GNSS	1 164 MHz - 1 300 MHz	1 100 MHz	1 364 MHz
GNSS	1 559 MHz - 1 610 MHz	1 463 MHz	1 706 MHz
ROMES	1 518 MHz - 1 559 MHz	1 450 MHz	1 627 MHz
Combined Equipment GNSS & ROMES (see note)	1 518 MHz - 1 610 MHz	1 450 MHz	1 706 MHz

NOTE: Combined GNSS and ROMES equipment is only used in the 1 518 MHz - 1 610 MHz band.

### EN 301 489-33

for EMC emission test

- The lower frequency of the exclusion band (EXband(lower) in ETSI EN 301 489-1 [1], clause 4.3) is the lower frequency of the operating bandwidth(s) (see ETSI EN 303 883 [15], clause 7.2.2).
- The upper frequency of the exclusion band (EXband(upper) in ETSI EN 301 489-1 [1], clause 4.3) is the upper frequency of the operating bandwidth(s) (see ETSI EN 303 883 [15], clause 7.2.2).

for EMC immunity test

- BWRX corresponds to the operating bandwidth of the UWB device (see ETSI EN 303 883 [15], clause 7.2.2).
- BandRX(lower) corresponds to the lower edge of the operating bandwidth (see ETSI EN 303 883 [15], clause 7.2.2).
- BandRX(upper) corresponds to the upper edge of the operating bandwidth (see ETSI EN 303 883 [15], clause 7.2.2).

**EN 301 489-50****Transmitter exclusion band**

The range of the exclusion band for transmitter (downlink DL) is defined as:

$$FDL_{low} - EB < f < FDL_{high} + EB$$

Where:

$FDL_{low}$  The lowest frequency of the downlink operating band

$FDL_{high}$  The highest frequency of the downlink operating band

EB Exclusion band defined according to the type of BS

**OTA type BS for FR1**

The BS transmitter exclusion band is the band of frequencies over which no tests of radiated immunity on transmitter are made.

For BS with a transmitter operating bandwidth < 100 MHz, EB is equal to BS channel bandwidth or 60 MHz, whichever is greater.

For BS with a transmitter operating bandwidth  $\geq$  100 MHz, EB is equal to BS channel bandwidth or 200 MHz, whichever is greater.

**Receiver exclusion band**

The range of the exclusion band for receiver (uplink UL) is defined as:

$$FUL_{low} - EB < f < FUL_{high} + EB$$

Where:

$FUL_{low}$  The lowest frequency of the uplink operating band

$FUL_{high}$  The highest frequency of the uplink operating band

EB Exclusion band defined according to the type of BS

**Non-AAS BS, Hybrid AAS BS and NR BS Type 1-C**

The exclusion bands shall be calculated using the operating bands as set out in ETSI TS 137 104 [21], clause 4.4.2 EB is equal to BS channel bandwidth or 20 MHz, whichever is greater.

**OTAAAS BS and NR BS Type 1-O**

The exclusion bands shall be calculated using the operating bands as set out in ETSI TS 137 105 [27], clause 5.

For BS with a receiver operating bandwidth < 100 MHz, EB is equal to BS channel bandwidth or 60 MHz, whichever is greater.

For BS with a receiver operating bandwidth  $\geq$  100 MHz, EB is equal to BS channel bandwidth or 200 MHz, whichever is greater.

**Multi-band BS**

For BS capable of multi-band operation, the exclusion band shall be the combination of the exclusion bands for each band, i.e. an exclusion band for each band according to clauses 4.3.1 and 4.3.2, shall be applied.

The total exclusion band extends from the lowest frequency of the lowest operating band up to the highest frequency of the highest operating band.

Where the operating bands are separated, the result will be a multiple separate exclusion bands.

**EN 301 489-52****GSM Transmitter exclusion band**

The exclusion band for transmitters and transmitter sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made.

The exclusion band for transmitters is as defined in clause 4.3.2.2 of ETSI EN 301 489-1 [1], 250 % of the channel width either side of the nominal operating frequency of the transmitter.

**GSM Receiver exclusion band**

The exclusion band for receivers and receiver sections of transceivers is the band of frequencies over which no immunity tests with radiated RF are made as defined in clause 4.3.3 of ETSI EN 301 489-1 [1] where  $n = 1$  and Channel width is 200 kHz.

**UTRA and E-UTRA Transmitter exclusion band****UTRA**

The frequency bands including in band emissions and out of band emissions are covered by the RF spectral mask specification and need no further consideration.

For the purpose of EMC specifications the transmitter exclusion band this shall be as defined in clause 4.3.2.2 of ETSI EN 301 489-1 [1].

**E-UTRA**

For the purpose of EMC specifications there shall be a transmitter exclusion band as defined in clause 4.3.2.2 of ETSI EN 301 489-1 [1] where BW Channel is the channel bandwidth as defined in ETSI TS 136 101 [9].

**UTRA and E-UTRA Receiver exclusion band**

As defined in clause 4.3.3 of ETSI EN 301 489-1 [1] where  $n = 1$  and Channel Width is as follows:

- UTRA Channel Width 5 MHz.
- E-UTRA Channel Width 20 MHz (see note).

NOTE: For systems that support multiple channel widths, the Channel Width used should be the widest support by the EUT.

**NR SA and NSA Transmitter exclusion band**

For the purpose of EMC specifications there shall be a transmitter exclusion band as defined in clause 4.3.2.2 of ETSI EN 301 489-1 [1] where BW Channel is the channel bandwidth as defined in ETSI TS 138 101-1 [14].

**NR SA and NSA Receiver exclusion band**

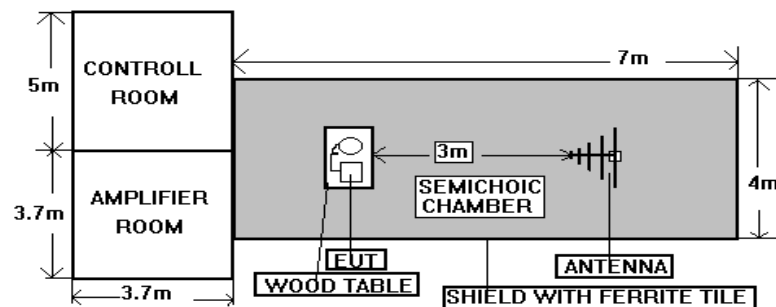
As defined in clause 4.3.3 of ETSI EN 301 489-1 [1] where  $n = 1$  and Channel Width is as follows:

- NR Channel Width 100 MHz.
- E-UTRA Channel Width 20 MHz (see note at clause 4.3.4).

### 6.2.5. Test Procedure

- The equipment to be tested is placed in the center of the enclosure on a wooden table. The equipment is then connected to power and signal leads according to pertinent installation instructions.
- The bilog antenna which is enabling the complete frequency range of 80 to 1000 MHz, the horn antenna which is enabling the complete frequency range 1000 to 6000 MHz is placed 3m away from the equipment. The required field strength is determined by placing the field strength meter(s) on top of or directly alongside the equipment under test and monitoring the field strength meter via a remote field strength indicator outside the enclosure while adjusting the continuous-wave to the applicable antennae.
- The test is normally performed with the generating antenna facing each of four sides of the EUT. The polarization of the field generated by the broadband (bilog) antenna necessitates testing each position twice, once with the antenna positioned vertically and again with the antenna positioned horizontally.
- The dwell time at each frequency shall not be less than the time necessary for the EUT to be exercised, and able to respond. Sensitive frequencies e.g. clock frequency(ies) and harmonics or frequencies of dominant interest shall be analyzed separately.
- At each of the above conditions, the frequency range is swept 80 to 6,000 MHz, pausing to adjust the R.F. signal level or to switch oscillators and antenna. The rate of sweep is in the order of  $1.5 \times 10^{-3}$  decades/s. The sensitive frequencies or frequencies of dominant interest may be discretely analyzed.

### 6.2.6. Test Setup



**NOTE : The SPORTON 7m x 4m x 4m semi-anechoic chamber is compliance with the sixteen point's uniform field requirement as stated in IEC 61000-4-3 Section 6.2.**

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.

**6.2.7. Test Result**

Test mode	Mode 1
Applicable Standard	ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09)
Final Test Result	<b>PASS</b>
Frequency Range	80 to 6,000 MHz
Electromagnetic field	3 V/m (unmodulated, r.m.s)
Amplitude modulated	80% AM (1 kHz)
Performance Criteria	A

Frequency Range MHz	Test field strength V/m	Antenna Polarization	Azimuth Degree	Test Result (Criteria)	Remark
80~6,000	3	V&H	0, 90, 180, 270	A	-

**Test Result - Packet error ratio(PER)**

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

**Test result PER=0%, less than 10% (Wi-Fi 2.4G)**

```
Reply from 192.168.1.1: bytes=32 time=5ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 820, Received = 820, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 91ms, Average = 4ms
```

**Test result PER=0%, less than 10% (Wi-Fi 5G)**

```
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 850, Received = 850, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1585ms, Average = 3ms
```



## 7. Uncertainty of Test Site

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

### 7.1. Measurement Uncertainty

Test Items	Test Site No.	$U_{LAB}$
Conducted Emissions (AMN)	CO01-NH	2.66 dB
Radiated Emissions below 1GHz	OS03-NH	5.07 dB
Radiated Emissions above 1GHz	03CH04-HY	3.53 dB



## 8. List of Measuring Equipment Used

### Conducted Emission - Test Date: 11/Apr/2022

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Receiver	R&S	ESR	102318	9k Hz - 3.6 GHz	26/Jul/2021	25/Jul/2022	Conduction (CO01-NH)
LISN	SCHAFFNER	NNB41	06/10024	9kHz - 30MHz	17/Dec/2021	16/Dec/2022	Conduction (CO01-NH)
Power Filter	CORCOM	MR12030	N/A	30A*2	NCR	NCR	Conduction (CO01-NH)
RF Cable-CON	Suhner Switzerland	RG223/U	CB004	9kHz - 30MHz	27/Dec/2021	26/Dec/2022	Conduction (CO01-NH)
software	Audix	E3	6.12160806	-	NCR	NCR	Conduction (CO01-NH)

NCR: No Calibration Required

### Radiated Emission below 1GHz - Test Date: 11/Apr/2022

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Open Area Test Site	SPORTON	OATS-10	OS03-NH	30 MHz - 1 GHz 10m, 3m	16/Oct/2021	15/Oct/2022	Radiation (OS03-NH)
Amplifier	HP	8447D	2944A08292	0.1 MHz - 1.3 GHz	02/Jul/2021	01/Jul/2022	Radiation (OS03-NH)
Spectrum Analyzer	R&S	FSP7	838858/038	9 kHz - 7GHz	21/Jun/2021	20/Jun/2022	Radiation (OS03-NH)
Receiver	R&S	ESCS30	100357	9 kHz - 2.75 GHz	07/May/2021	06/May/2022	Radiation (OS03-NH)
Bilog Antenna With 5dB Attenuator	CHASE	CBL6112D	25234	30 MHz - 2 GHz	24/Apr/2021	23/Apr/2022	Radiation (OS03-NH)
Turn Table	EMCO	2080	9805-2065	0 - 360 degree	NCR	NCR	Radiation (OS03-NH)
Antenna Mast	EMCO	2075	9804-2151	1 m - 4 m	NCR	NCR	Radiation (OS03-NH)
RF Cable-R10m	HSCN	RG213U	2X11N	30 MHz - 1 GHz	13/Jul/2021	12/Jul/2022	Radiation (OS03-NH)
Software	Audix	E3	Ver.4	-	NCR	NCR	Radiation (OS03-NH)

NCR: No Calibration Required.

**Radiated Emission above 1GHz - Test Date: 21/Apr/2022**

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Test Receiver	R&S	ESU-26	100422	20Hz ~ 26.5GHz	05/Nov/2021	04/Nov/2022	Radiation (03CH04-HY)
Turn Table	Chaintek	3000	TT9664	0 ~ 360 degree	NCR	NCR	Radiation (03CH04-HY)
Antenna Mast	MF	MFA-515BSN	MFA-515BSN08 193	1 m ~ 4 m	NCR	NCR	Radiation (03CH04-HY)
3m Semi Anechoic Chamber (Site V.S.W.R)	RIKEN	SAC-3M	03CH04-HY	1 GHz ~ 18 GHz 3m	18/Feb/2022	17/Feb/2023	Radiation (03CH04-HY)
Microwave Preamplifier	Agilent	8449B	3008A02364	1GHz ~ 26.5GHz	08/Mar/2022	07/Mar/2023	Radiation (03CH04-HY)
Horn Antenna	SCHWARZBECK	BBHA9120 D	BBHA 9120 D-1130	1 GHz ~ 18 GHz	27/Dec/2021	26/Dec/2022	Radiation (03CH04-HY)
RF Cable-HIGH	HUBER+SUHNER	SUOFLEX 104	SN805197/4+M Y39497	1 GHz ~ 18 GHz	07/Mar/2022	06/Mar/2023	Radiation (03CH04-HY)
Band Reject Filter	Wi	WRCGV10	41	2382-2402-2480 -2500MHz	30/Apr/2021	29/Apr/2022	Radiation (03CH04-HY)
Band Reject Filter	MTJ	MBR-5150-5250 -45-S1	160413001	5150 ~ 5250MHz	30/Apr/2021	29/Apr/2022	Radiation (03CH04-HY)
Software	Sporton	SENSE-EMI	V5.10.7	-	NCR	NCR	Radiation (03CH04-HY)

NCR: No Calibration Required.



**EMC TEST REPORT****Report No. : EH211912****EMS - Test Date: 16/Apr/2022**

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
ESD Simulator	TESEQ	NSG 437	192	Air: 0.5kV~30kV Contact: 0kV ~ 30kV	04/Oct/2021	03/Oct/2022	ESD
Signal Generator	ROHDE&SCHWARZ	SMB100A	108589	9kHz ~ 6GHz	01/Apr/2022	31/Mar/2023	RS
Power Amplifier	MILMEGA	80RF1000-300	1079234	80MHz ~ 1GHz, 300W	NCR	NCR	RS
Power Amplifier	MILMEGA	AS0860B-50/50	1079525	0.8 ~ 6GHz ,50W(0.8GHz ~2GHz and 1.8GHz~6.0GHz)	NCR	NCR	RS
Amplifier controller	MILMEGA	AC-001	N/A	N/A	NCR	NCR	RS
Antenna	AR	ATL80M1G	348541	80MHz ~ 1GHz, 30W	NCR	NCR	RS
Antenna	SCHWARZBECK	STLP 9149	STLP9149 #490	700MHz ~ 10.5GHz	NCR	NCR	RS
EPM Series Power Meter	KEYSIGHT	N1914A	MY57070002	9 kHz to 110 GHz	01/Apr/2022	31/Mar/2023	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57020004	9kHz ~ 6GHz	01/Apr/2022	31/Mar/2023	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57030009	9kHz ~ 6GHz	01/Apr/2022	31/Mar/2023	RS
Fiber Optic modem	ETS-LINDGREN	HI-4413P	N/A	N/A	NCR	NCR	RS
Dual Directional Coupler	WERLATONE	C10117-10	112093	N/A	NCR	NCR	RS
Dual Directional Coupler	WERLATONE	C3908-10	112109	N/A	NCR	NCR	RS
RS immunity Test system	Sporton combination	Sporton RS	RS06HY	80MHz ~ 6GHz	01/Jul/2021	30/Jun/2022	RS
RF-Switch Network	TESEQ	RFB 2000	45818	N/A	NCR	NCR	RS
Probe	ETS-LINDGREN	HI-6105	00130664	0.1 MHz - 6GHz	02/Jul/2021	01/Jul/2022	RS
Software	Audix	i2	Version:5	-	NCR	NCR	RS

NCR: No Calibration Required.

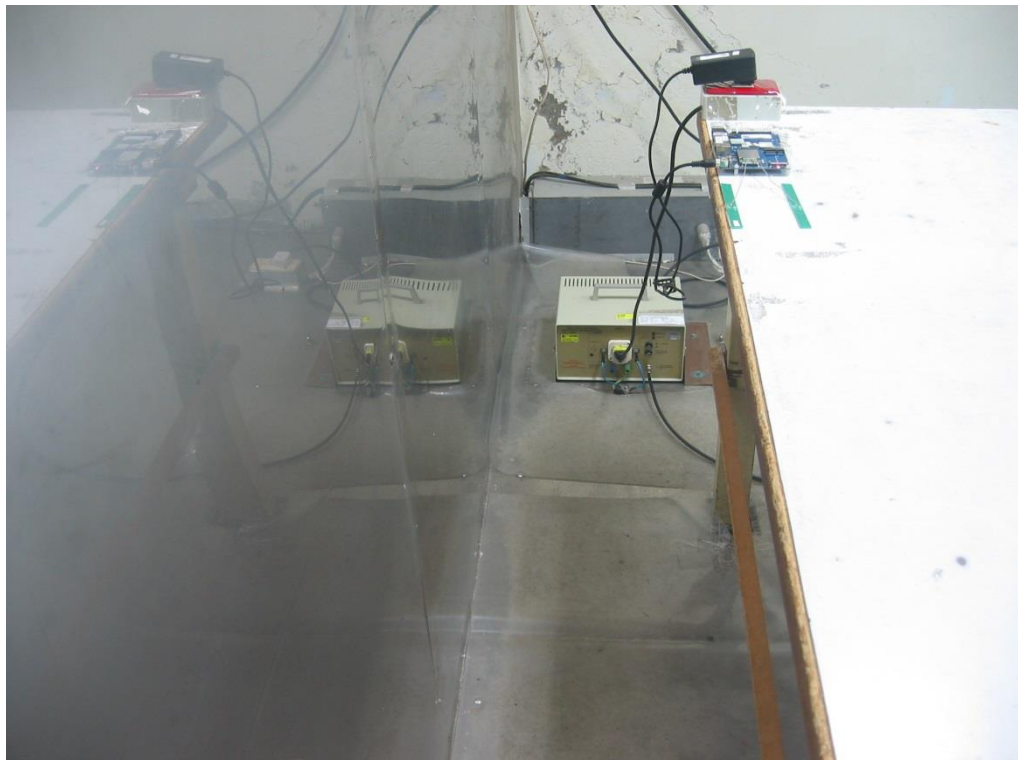
## Appendix A. Test Photos

### 1. Photographs of Conducted Emissions Test Configuration

**Front View**



**Side View**



Under Table View





## 2. Photographs of Radiated Emissions Test Configuration

For radiated emissions below 1GHz

**Front View**



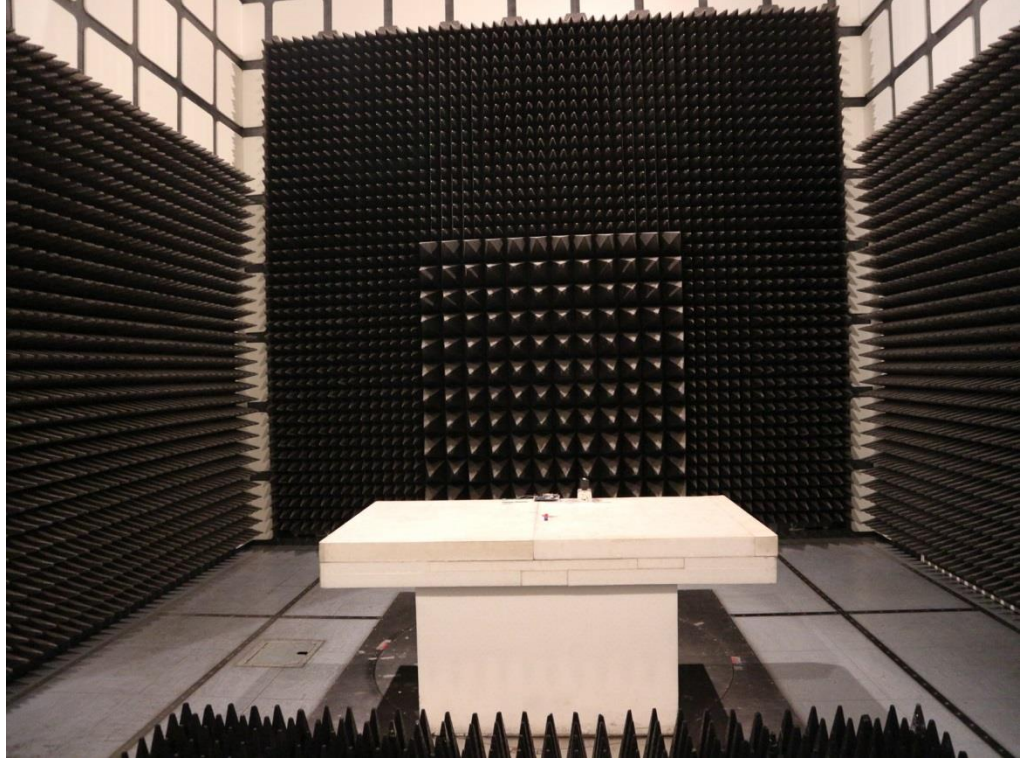
**Rear View**



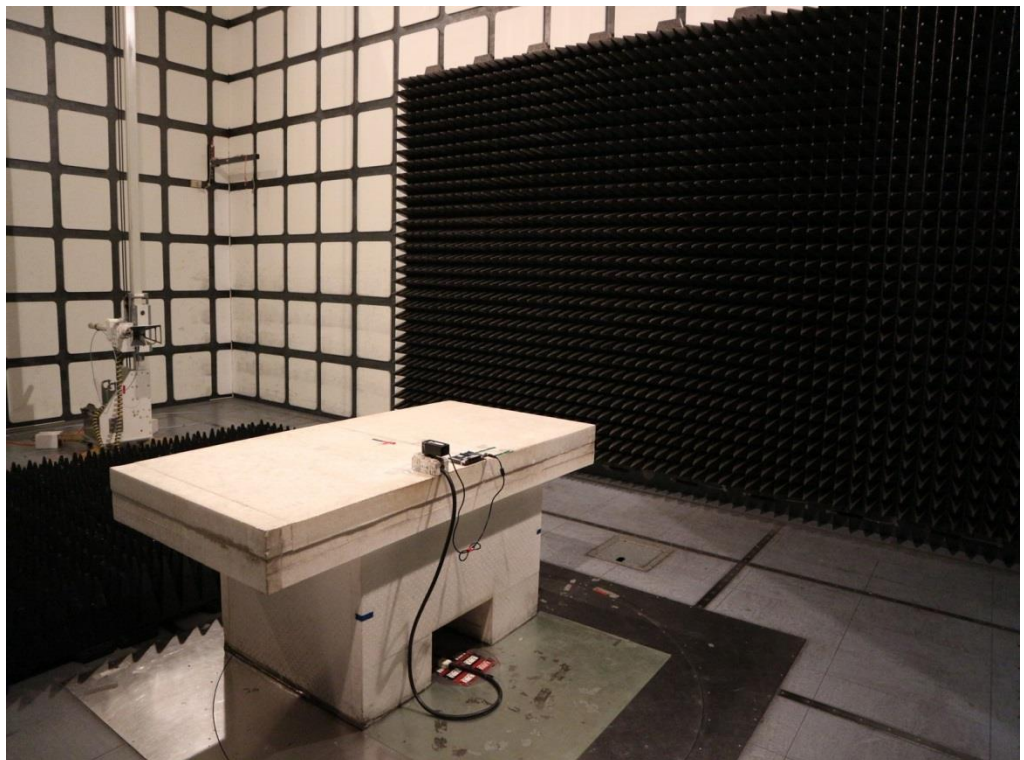


For radiated emissions above 1GHz

**Front View**

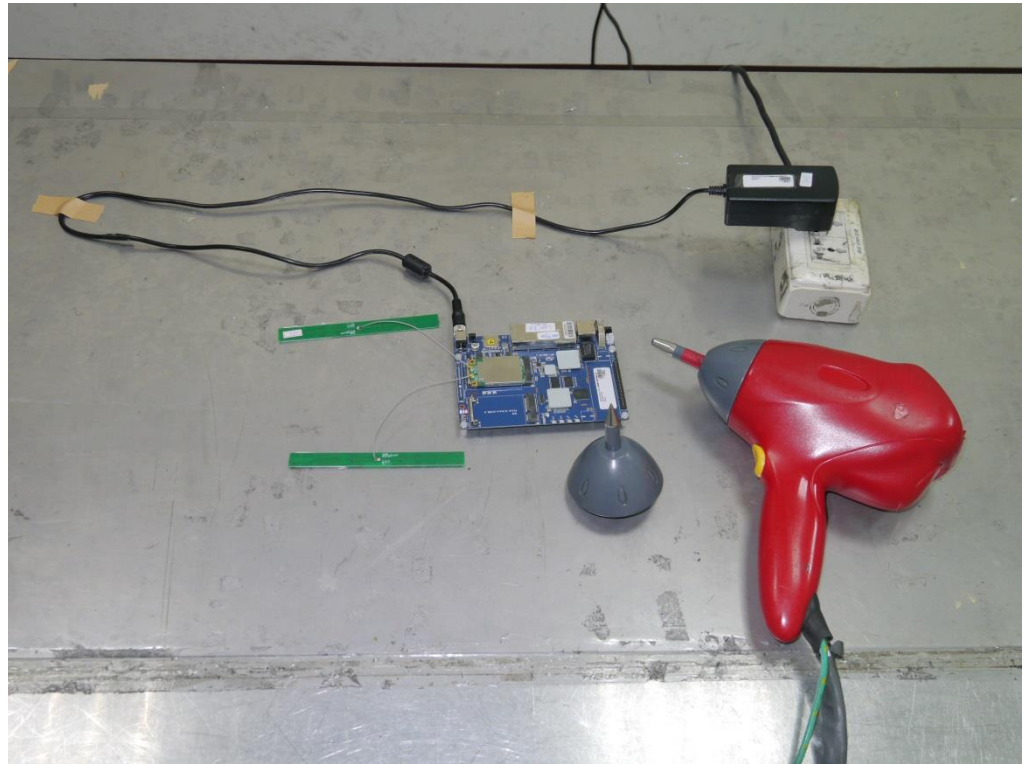


**Rear View**

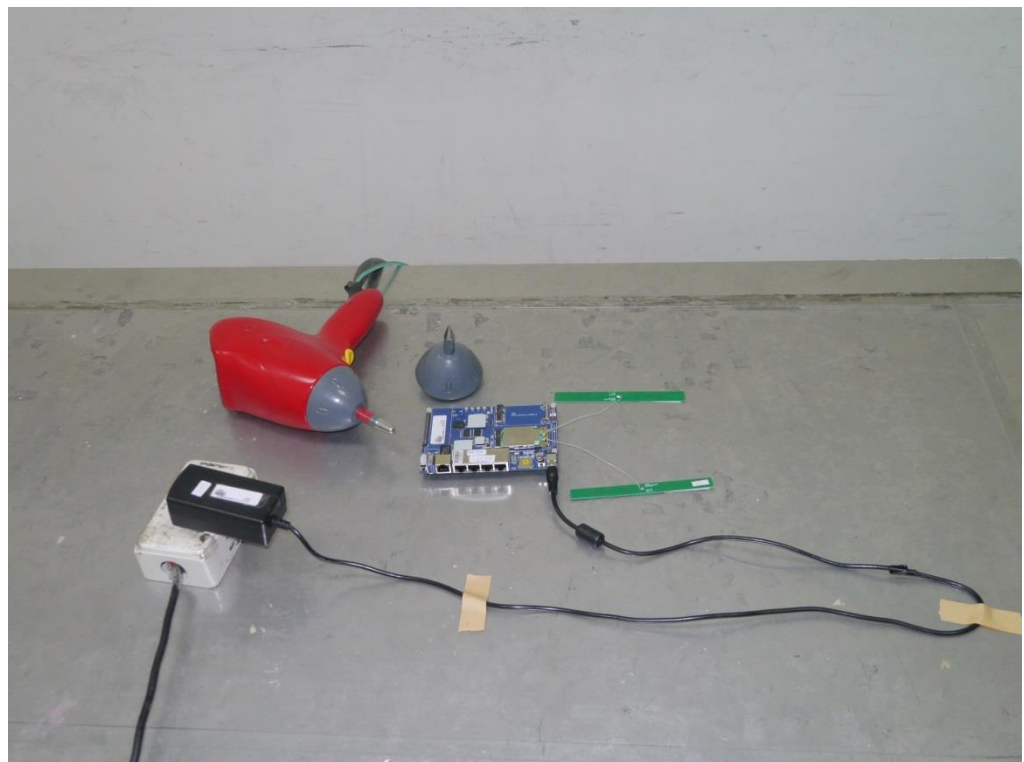


### 3. Photographs of ESD Immunity Test Configuration

Front View



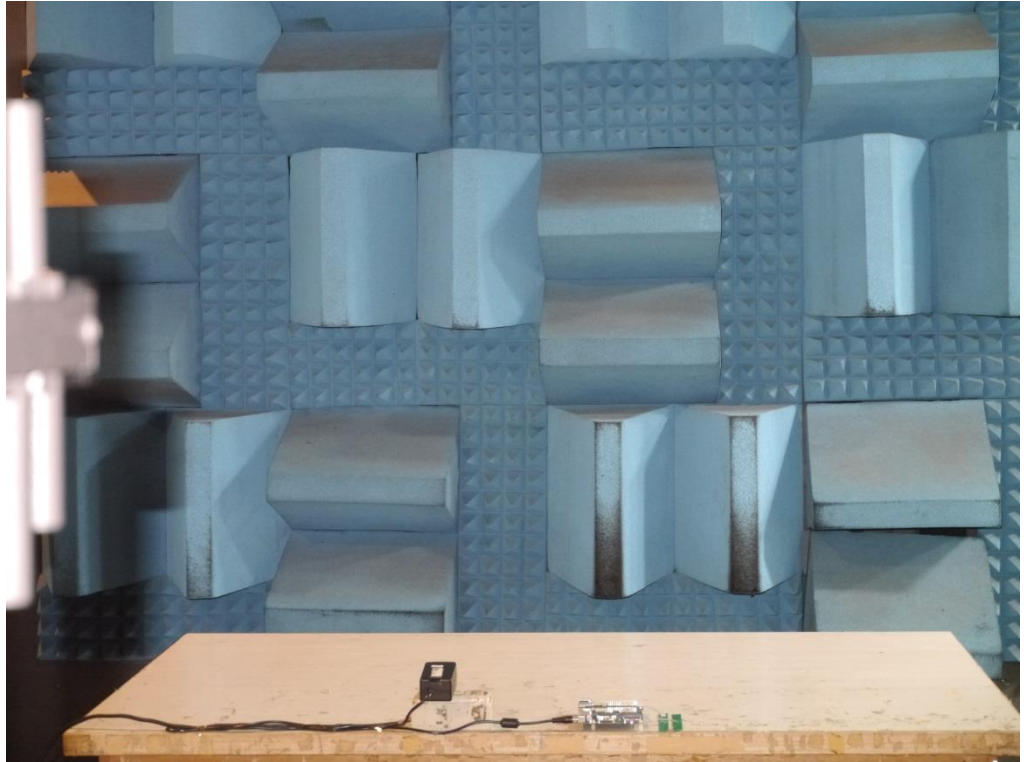
Rear View



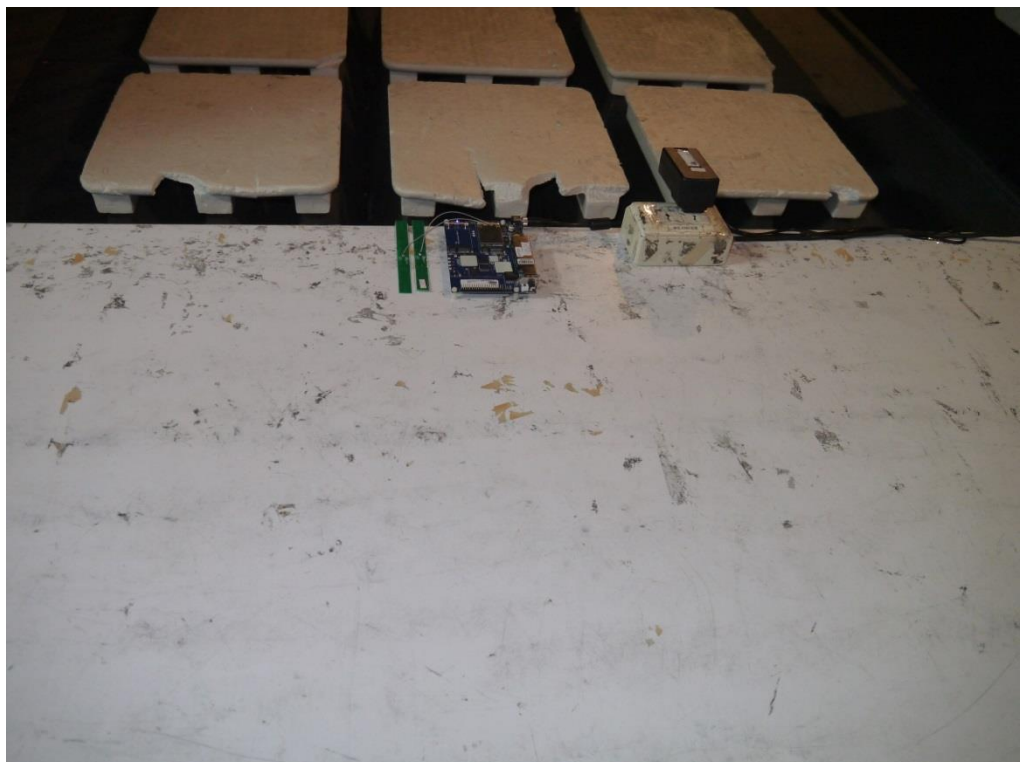


#### 4. Photographs of RS Immunity Test Configuration

**Front View**



**Rear View**



————THE END————