

# VERIFICATION OF COMPLIANCE

- **Equipment** : AC-DC Switching Power Supply
- Model No.** : TCI 500-112-T 、 TCI 500-124-T 、 TCI 500-148-T 、  
TCI 500-112U-T 、 TCI 500-124U-T 、 TCI 500-148U-T
- Applicant** : Traco Electronic AG  
Sihlbruggstrasse 111, CH-6340 Baar, Switzerland

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

The equipment was **Passed** the test performed according to the following Standard

**EN 55032:2015+A11:2020 Class A,**

**EN IEC 61000-3-2:2019, EN 61000-3-3:2013+A1:2019,**

**EN 55035:2017+A11:2020**

**(IEC 61000-4-2 Edition 2.0 2008-12, IEC 61000-4-3 Edition 3.2 2010-04,**

**IEC 61000-4-4 Edition 3.0 2012-04, IEC 61000-4-5 Edition 3.1 2017-08,**

**IEC 61000-4-6 Edition 4.0 2013-10, IEC 61000-4-8 Edition 2.0 2009-09,**

**IEC 61000-4-11 Edition 3.0 2020-01).**

The test was carried out on **Sep. 24, 2022** at **SPORTON INTERNATIONAL INC.**

**Hsinhua Laboratory.**

A handwritten signature in blue ink, appearing to read 'William Li', is written over a horizontal line.

**William Li**

**SPORTON INTERNATIONAL INC. Hsinhua Laboratory**

No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)



# EMC TEST REPORT

**Equipment** : AC-DC Switching Power Supply  
**Brand Name** : TRACO  
**Model Name** : TCI 500-112-T 、 TCI 500-124-T 、 TCI 500-148-T 、  
TCI 500-112U-T 、 TCI 500-124U-T 、 TCI 500-148U-T  
**Applicant** : Traco Electronic AG  
Sihlbruggstrasse 111, CH-6340 Baar, Switzerland  
**Manufacturer** : Traco Electronic AG  
Sihlbruggstrasse 111, CH-6340 Baar, Switzerland  
**Standard** : EN 55032:2015+A11:2020 Class A  
EN IEC 61000-3-2:2019  
EN 61000-3-3:2013+A1:2019  
EN 55035:2017+A11:2020

The product was received on Aug. 02, 2022, and testing was started from Aug. 03, 2022 and completed on Sep. 24, 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.)



## Table of Contents

<b>History of this test report.....</b>	<b>3</b>
<b>Summary of Test Result .....</b>	<b>4</b>
<b>1. General Description of Equipment under Test .....</b>	<b>6</b>
1.1. Basic Description of Equipment under Test .....	6
1.2. Feature of Equipment under Test.....	6
1.3. Table for Multiple Listing.....	6
<b>2. Test Configuration of Equipment under Test .....</b>	<b>7</b>
2.1. Details of EUT Test Modes.....	7
2.2. Description of Test System.....	8
2.3. Connection Diagram of Test System.....	8
2.4. Details of EUT Test Setup .....	9
<b>3. General Information of Test.....</b>	<b>10</b>
3.1. Test Facilities .....	10
3.2. Test Standards .....	11
3.3. Test Voltage/Frequencies.....	11
3.4. Test Distance and Frequency Range Investigated .....	11
3.5. Operating Condition.....	11
3.6. Notice for Class A Product .....	11
<b>4. Emissions Measurement .....</b>	<b>12</b>
4.1. Conducted Emissions at Powerline .....	12
4.2. Radiated Emission below 1GHz .....	18
4.3. Harmonic Current Emissions Measurement.....	26
4.4. Voltage Fluctuations and Flicker Measurement .....	28
<b>5. Immunity Measurement .....</b>	<b>30</b>
5.1. General performance criteria .....	30
5.2. Electrostatic Discharge (ESD) .....	31
5.3. Radio Frequency Electromagnetic Field (RS) .....	38
5.4. Electrical Fast Transient/Burst (EFT/B).....	41
5.5. Surges.....	44
5.6. Conducted Disturbances Induced by Radio-Frequency Field (CS) .....	47
5.7. Power Frequency Magnetic Field (PFMF).....	50
5.8. Voltage Dips and Voltage Interruptions (DIPs).....	53
<b>6. Uncertainty of Test Site .....</b>	<b>55</b>
6.1. Measurement Uncertainty .....	55
<b>7. List of Measuring Equipment Used.....</b>	<b>56</b>
<b>Appendix A. Test Photos</b>	
<b>Photographs of EUT v01</b>	





### 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>					
4.1	A.3	EN 55032:2015+A11:2020 Class A	Conducted Emission	PASS	Under limit 13.13 dB at 27.001 MHz
-	A.3		Conducted Emissions of asymmetric mode	Not Applicable	Note 1
4.2	A.2		Radiated Emissions below 1GHz	PASS	Under limit 3.31 dB at 47.820 MHz
-	A.2		Radiated Emissions above 1GHz	Not Applicable	Note 2
4.3	6.2	EN IEC 61000-3-2:2019	Harmonic Current Emissions	PASS	-
4.4	6.1	EN 61000-3-3:2013+A1:2019	Voltage Fluctuations and Flicker	PASS	-
<p>Note 1: There are no wired network ports on the EUT.</p> <p>Note 2: The highest frequency of the internal sources of the EUT is less than 108MHz, so the measurement shall only be made up to 1GHz.</p>					

Report Clause	Ref Std. Clause	Test reference standard	Test Items	Result (PASS/FAIL)	Remark	
<b>Immunity Tests and Conformance Test Specifications - EN 55035:2017+A11:2020</b>						
5.2	4.2.1	IEC 61000-4-2 Edition 2.0 2008-12	ESD	PASS	-	
5.3	4.2.2.2	IEC 61000-4-3 Edition 3.2 2010-04	RS	PASS	-	
5.4	4.2.4	IEC 61000-4-4 Edition 3.0 2012-04	EFT/B	Power Port	PASS	-
				Analogue/digital data ports	Not Applicable	Note 1
5.5	4.2.5	IEC 61000-4-5 Edition 3.1 2017-08	Surges	Power Port	PASS	-
				Analogue/digital data ports	Not Applicable	Note 1
5.6	4.2.2.3	IEC 61000-4-6 Edition 4.0 2013-10	CS	Power Port	PASS	-
				Analogue/digital data ports	Not Applicable	Note 1
5.7	4.2.3	IEC 61000-4-8 Edition 2.0 2009-09	Power Frequency Magnetic Fields	PASS	-	
5.8	4.2.6	IEC 61000-4-11 Edition 3.0 2020-01	Voltage dips	PASS	-	
			Voltage interruptions	PASS	-	
<p>According to the applicant's requirements, the version of the normative reference used in this test report is specified by the applicant.</p> <p>Note 1: There are no Analogue/digital data ports on the EUT.</p>						



**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:**

The test configuration and test mode were recorded in this test report are declared by the manufacturer.

**Reviewed by: Cage Chuang**

**Report Producer: Julie Tseng**



# 1. General Description of Equipment under Test

## 1.1. Basic Description of Equipment under Test

Equipment : AC-DC Switching Power Supply  
Model No. : TCI 500-112-T 、 TCI 500-124-T 、 TCI 500-148-T 、  
TCI 500-112U-T 、 TCI 500-124U-T 、 TCI 500-148U-T  
Power Supply Type : Switching  
AC Power Cord : Non-Shielded, 1.5 m, 3 pin (Conducted Emission)  
Non-Shielded, 1.2 m, 3 pin (Radiated emission)  
The maximum operating frequency : 400 kHz

## 1.2. Feature of Equipment under Test

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

## 1.3. Table for Multiple Listing

Model Name	Description
TCI 500-112-T 、 TCI 500-124-T 、 TCI 500-148-T 、 TCI 500-112U-T 、 TCI 500-124U-T 、 TCI 500-148U-T	The difference of models is in sales marketing.

Note: The information is provided by manufacturer.



## 2. Test Configuration of Equipment under Test

### 2.1. Details of EUT Test Modes

Model No.: TCI 500-112-T 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. FULL LOAD,AC IN 3 PIN Mode 2. FULL LOAD,AC IN 2 PIN cause "mode 1" generated the worst test result; it was reported as final data.
<b>Radiated Emissions &lt;below 1GHz&gt;</b>	Mode 1. FULL LOAD,AC IN 3 PIN Mode 2. FULL LOAD,AC IN 2 PIN cause "mode 1" generated the worst test result; it was reported as final data.

Test Items	Description of test modes
<b>Harmonic and Flicker Emissions</b>	Mode 1. FULL LOAD,AC IN 3 PIN
<b>EMS</b>	Mode 1. FULL LOAD,AC IN 3 PIN



## 2.2. Description of Test System

### Conducted emission and radiated emission below 1GHz

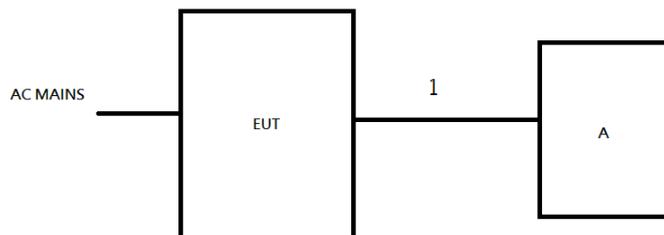
No.	Peripheral	Manufacturer	Model Number	FCC ID	Remarks
For Local					
A	Dummy LOAD	N/A	N/A	N/A	Client provided

### EMS

No.	Peripheral	Manufacturer	Model Number	Signal Cable	Cable Type	Length (m)	Remarks
For Local							
A	Dummy Load	N/A	N/A	DC Power Cable *2	Non-Shielded	0.4	Client provided
B	Multi-meter	YFE	YF-303	Probe Cable*2	Non-Shielded	1.2	-

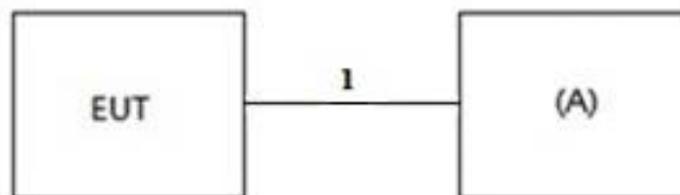
## 2.3. Connection Diagram of Test System

**Test Setup Diagram - Conducted emission**



No.	Types of Cables	Shielding on Cable	Length (m)	Remarks
1	DC	Non-Shielded	0.4	-

**Test Setup Diagram - Radiated emission below 1GHz**



No.	Types of Cables	Shielding on Cable	Length (m)	Remarks
1	DC	Non-Shielded	0.4	-



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

The device under test was connected to the resistive load for testing in full load mode.



### 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	CO04-HY	Hank He	21.5~22.0	52~53	-	10/Aug/2022	-
Radiated Emissions (below 1GHz)	OS03-NH	Louis Lin	29.1~29.2	58.5~58.6	-	03/Aug/2022	-
Harmonic Current Emissions	EX02-HY	Junsun	24.6~24.8	47~49	100.1	23/Sep/2022	-
Voltage Fluctuations and Flicker	EX02-HY	Junsun	24.6~24.8	47~49	100.1	23/Sep/2022	-
ESD	ES02-HY	Alex	23.5~23.9	43~44	100.1	11/Aug/2022	-
RS	RS01-HY	Junsun	23.4~23.7	44~47	100.1	24/Sep/2022	-
EFT/B	EX01-HY	Junsun	24.2~24.5	48~51	100.1	20/Sep/2022	-
Surge	EX01-HY	Junsun	24.2~24.5	48~51	100.1	20/Sep/2022	-
CS	CS03-HY	Junsun	24.4~24.6	45~48	100.1	24/Sep/2022	-
Power Frequency Magnetic Fields	EX02-HY	Junsun	24.6~24.8	47~49	100.1	23/Sep/2022	-
Voltage dips and interruptions	EX01-HY	Junsun	24.2~24.5	48~51	100.1	20/Sep/2022	-



### 3.2. Test Standards

Test items	Test Standards and Test Procedures
Radiated and Conducted Emissions	European Standard EN 55032 Class A
Harmonics	European Standard EN IEC 61000-3-2
Voltage Fluctuations	European Standard EN 61000-3-3
EMS	European Standard EN 55035 (ESD: IEC 61000-4-2, RS: IEC 61000-4-3, EFT: IEC 61000-4-4, SURGES: IEC 61000-4-5, CS: IEC 61000-4-6, PFMF: IEC 61000-4-8, DIPs: IEC 61000-4-11)

### 3.3. Test Voltage/Frequencies

Power Supply Type	Voltage/Frequencies
AC Mains	230V / 50Hz

### 3.4. Test Distance and Frequency Range Investigated

Test Items	Frequency Range	Remark
Powerline Conducted Emissions	150 kHz to 30 MHz	-
Radiated Emissions (below 1GHz)	30 MHz to 1,000 MHz	Measurement distance is 10 m.
Radio frequency electromagnetic field immunity	80 to 1,000 MHz	Measurement distance is 3 m.
	1,800 MHz / 2,600 MHz / 3,500 MHz / 5,000 MHz	Measurement distance is 3 m.
Conducted immunity	150 kHz to 80 MHz	-

### 3.5. Operating Condition

- Customers request this specification for test plan.

### 3.6. Notice for Class A Product

**This Notice is for class A product only. If the Equipment under Test is a class B product, this notice should be disregarded.**

Class A ITE is a category of all other ITE which satisfies the class A ITE limits but not the class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use:

#### Warning

This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

## 4. Emissions Measurement

The EUT is which satisfies the Class A disturbance limits.

### 4.1. Conducted Emissions at Powerline

#### 4.1.1.Limit

conducted emissions from the AC mains power ports of Class A equipment			
Frequency range MHz	Coupling device	Detector type / bandwidth	Class A limits dB( $\mu$ V)
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

conducted emissions from the AC mains power ports of Class B equipment			
Frequency range MHz	Coupling device	Detector type / bandwidth	Class B limits dB( $\mu$ V)
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: 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**

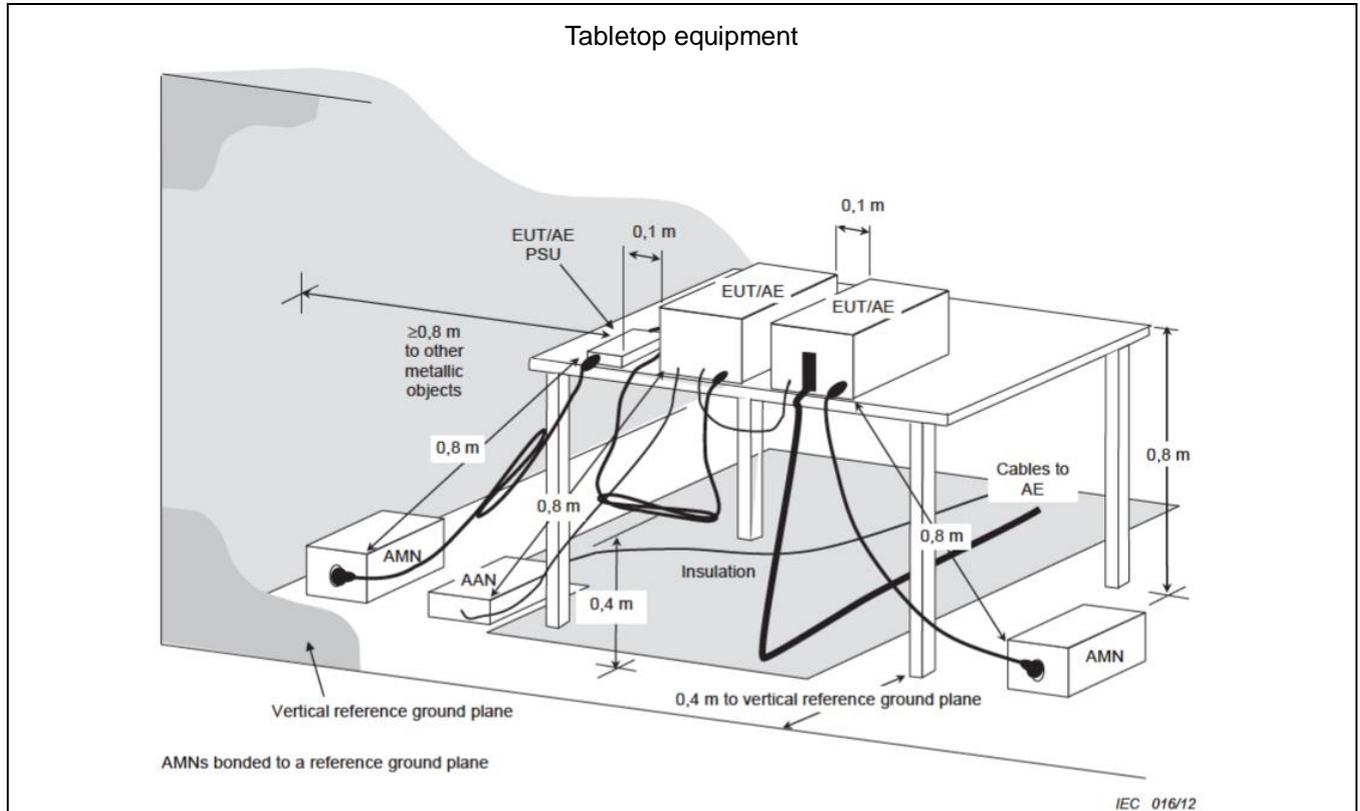
The measured Level is calculated using:

$$\text{Corrected Reading (dB}\mu\text{V)} = \text{Raw(Read Level)} + (\text{LISN Factor}) + \text{CL(Cable Loss)} + \text{AT(Attenuator)}$$

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, attenuation 10dB, the signal strength would be calculated:

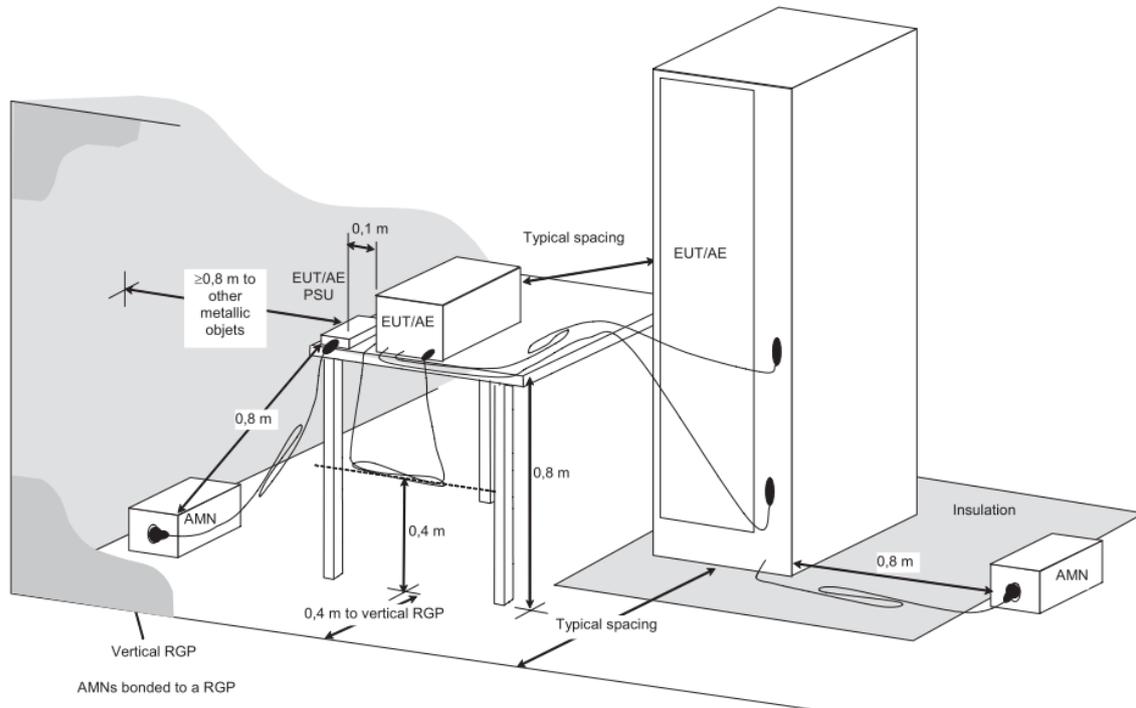
$$\text{Corrected Reading (dB}\mu\text{V)} = 36.39 \text{ dB}\mu\text{V} + 10.48 \text{ dB} + 0.10 \text{ dB} + 10 \text{ dB} = 56.97 \text{ dB}\mu\text{V}$$

**4.1.4. Typical Test Setup Layout**



- a). AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
- b). EUT is connected to one artificial mains network (AMN)
- c). All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
- d). Rear of EUT to be flushed with rear of table top.
- e). 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.
- f). 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.
- g). Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
- h). Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.

Floor-standing equipment



IEC 021/12

- a). AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
- b). EUT is connected to one artificial mains network (AMN)
- c). All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
- d). Rear of EUT to be flushed with rear of table top.
- e). 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.
- f). 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.
- g). Mains cords and signal cables shall be positioned for their entire lengths, as far as possible, at 40 cm from the vertical reference plane.
- h). Cables of hand operated devices, such as keyboards, mice, etc. shall be placed as for normal usage.
- i). The EUT shall be insulated (by insulation of maximum thickness of 150 mm) from the horizontal reference ground plane.

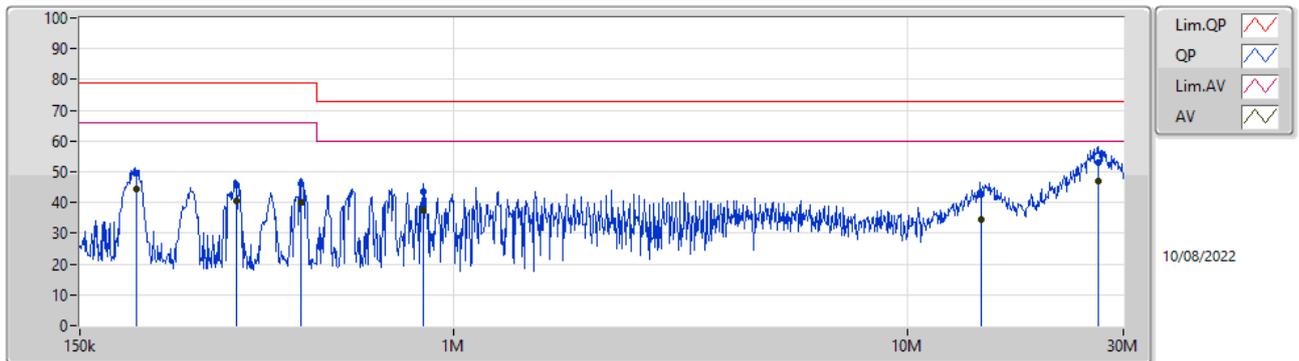


**4.1.5. Test Result**

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

Line

**Mode 1**

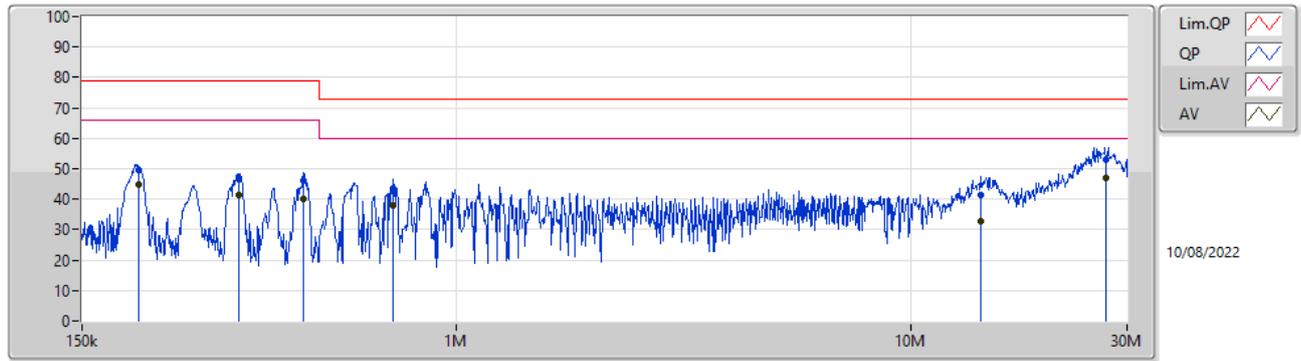


Type	Freq (Hz)	Level (dBUV)	Limit (dBUV)	Margin (dB)	Factor (dB)	Condition	Comment	Raw (dBUV)	LISN (dB)	CL (dB)	AT (dB)
QP	200.052k	49.37	79.00	-29.63	19.63	Line	-	29.74	9.69	0.03	9.91
AV	200.052k	44.41	66.00	-21.59	19.63	Line	-	24.78	9.69	0.03	9.91
QP	332.709k	45.78	79.00	-33.22	19.63	Line	-	26.15	9.68	0.04	9.91
AV	332.709k	40.58	66.00	-25.42	19.63	Line	-	20.95	9.68	0.04	9.91
QP	461.279k	46.05	79.00	-32.95	19.63	Line	-	26.42	9.68	0.04	9.91
AV	461.279k	39.91	66.00	-26.09	19.63	Line	-	20.28	9.68	0.04	9.91
QP	856.647k	43.64	73.00	-29.36	19.65	Line	-	23.99	9.68	0.05	9.92
AV	856.647k	37.41	60.00	-22.59	19.65	Line	-	17.76	9.68	0.05	9.92
QP	14.592M	42.53	73.00	-30.47	19.97	Line	-	22.56	9.80	0.24	9.93
AV	14.592M	34.59	60.00	-25.41	19.97	Line	-	14.62	9.80	0.24	9.93
QP	26.364M	53.12	73.00	-19.88	20.05	Line	-	33.07	9.80	0.32	9.93
AV	26.364M	46.83	60.00	-13.17	20.05	Line	"Worst"	26.78	9.80	0.32	9.93



Neutral

**Mode 1**



Type	Freq (Hz)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Factor (dB)	Condition	Comment	Raw (dBuV)	LISN (dB)	CL (dB)	AT (dB)
QP	199.387k	49.70	79.00	-29.30	19.66	Neutral	-	30.04	9.72	0.03	9.91
AV	199.387k	44.86	66.00	-21.14	19.66	Neutral	-	25.20	9.72	0.03	9.91
QP	331.848k	46.51	79.00	-32.49	19.67	Neutral	-	26.84	9.72	0.04	9.91
AV	331.848k	41.38	66.00	-24.62	19.67	Neutral	-	21.71	9.72	0.04	9.91
QP	462.037k	46.10	79.00	-32.90	19.67	Neutral	-	26.43	9.72	0.04	9.91
AV	462.037k	39.94	66.00	-26.06	19.67	Neutral	-	20.27	9.72	0.04	9.91
QP	725.252k	43.48	73.00	-29.52	19.70	Neutral	-	23.78	9.73	0.05	9.92
AV	725.252k	37.87	60.00	-22.13	19.70	Neutral	-	18.17	9.73	0.05	9.92
QP	14.263M	41.21	73.00	-31.79	20.10	Neutral	-	21.11	9.94	0.23	9.93
AV	14.263M	32.84	60.00	-27.16	20.10	Neutral	-	12.74	9.94	0.23	9.93
QP	27.001M	53.04	73.00	-19.96	20.35	Neutral	-	32.69	10.10	0.32	9.93
AV	27.001M	46.87	60.00	-13.13	20.35	Neutral	"Worst"	26.52	10.10	0.32	9.93



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

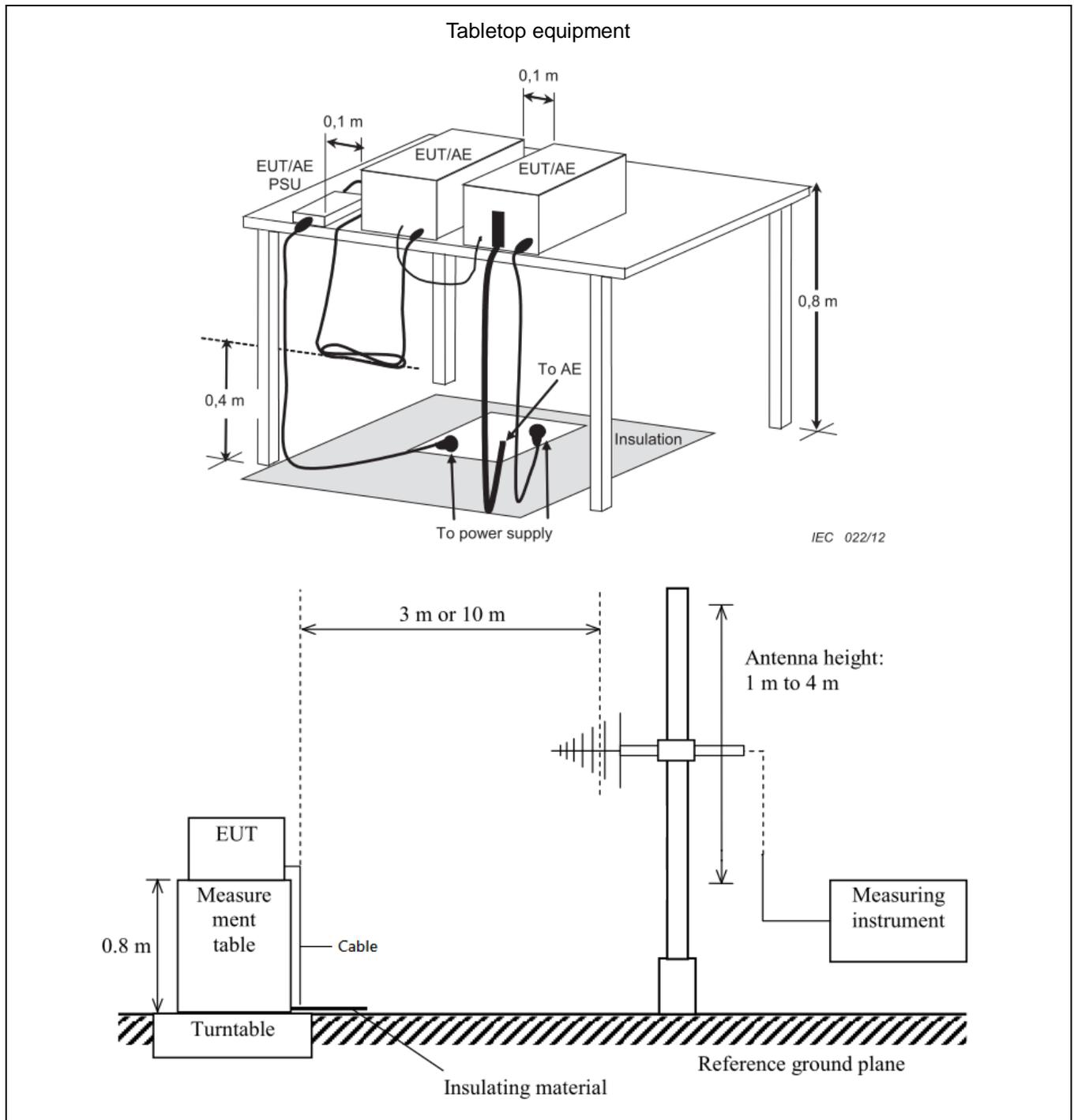


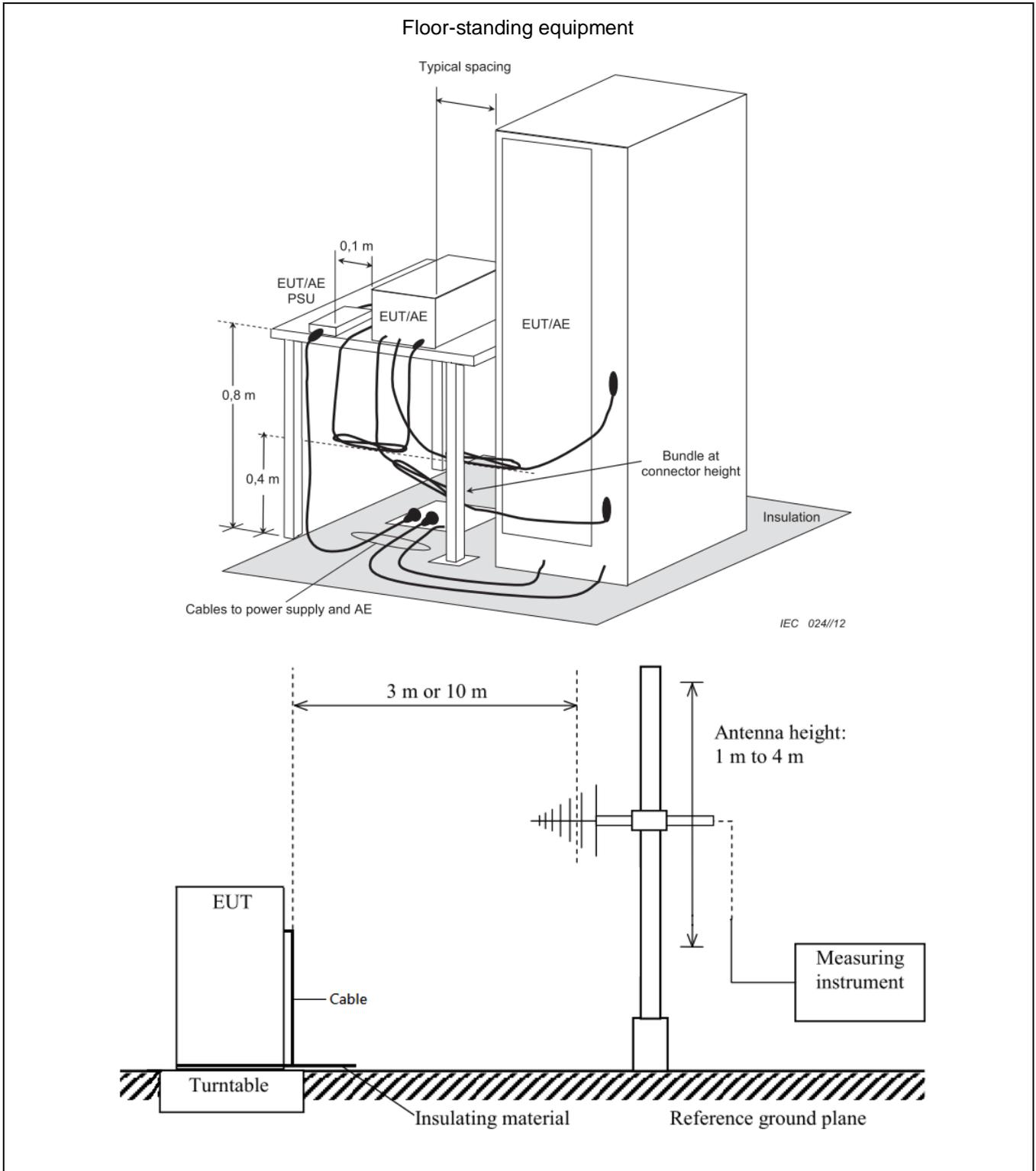
- (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f). Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
  - g). If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then 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**



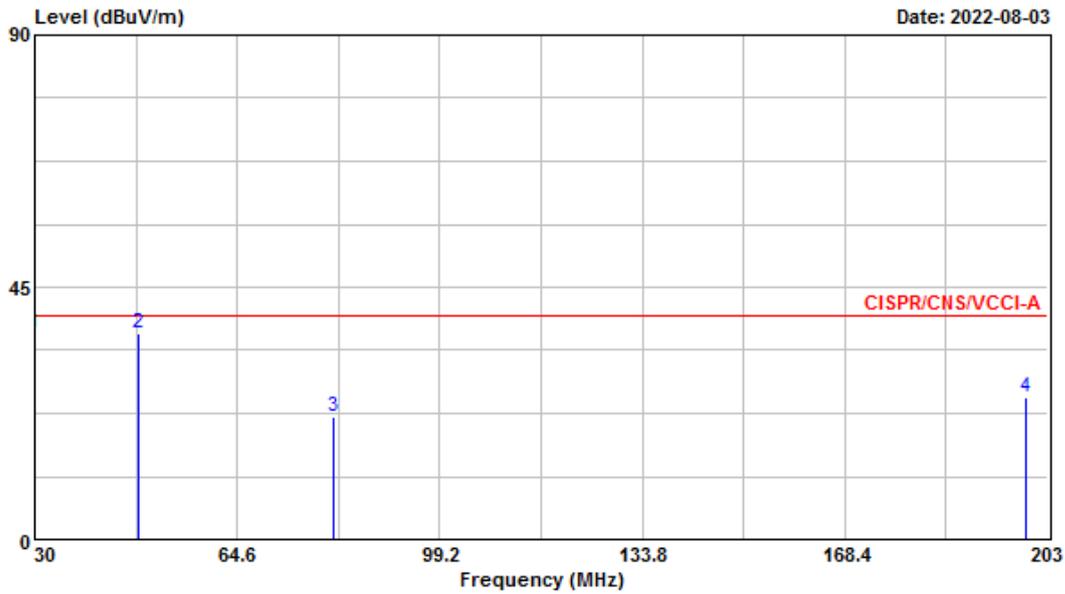




**4.2.5. Test Result**

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

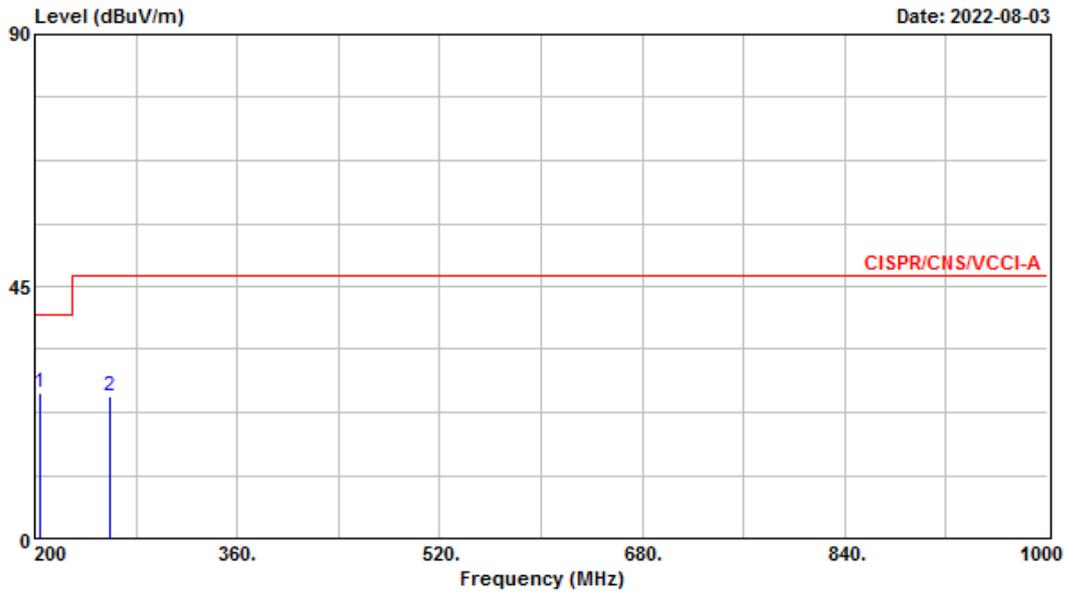
**Vertical**



	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	30.000	36.65	-3.35	40.00	40.72	23.46	1.00	28.53	Peak	---	---
2	47.820	36.69	-3.31	40.00	49.69	14.26	1.25	28.51	Peak	100	182
3	81.040	21.86	-18.14	40.00	36.52	12.09	1.70	28.45	Peak	---	---
4	199.190	25.27	-14.73	40.00	36.06	14.43	2.79	28.01	Peak	---	---



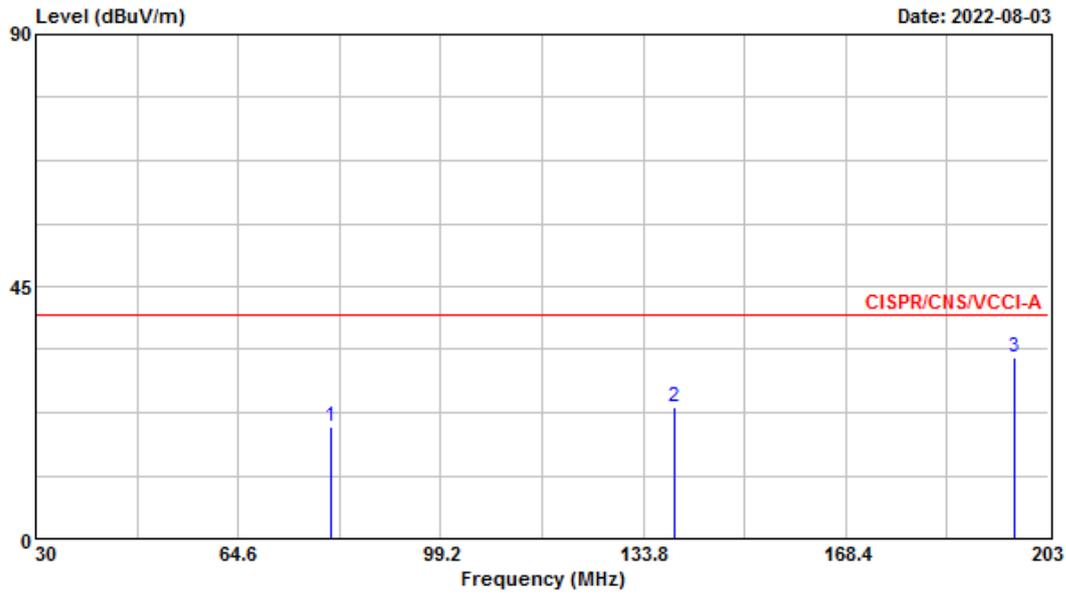
**Vertical**



	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	204.800	25.94	-14.06	40.00	36.69	14.40	2.84	27.99	Peak	---	---
2	260.000	25.22	-21.78	47.00	31.06	18.79	3.20	27.83	Peak	---	---



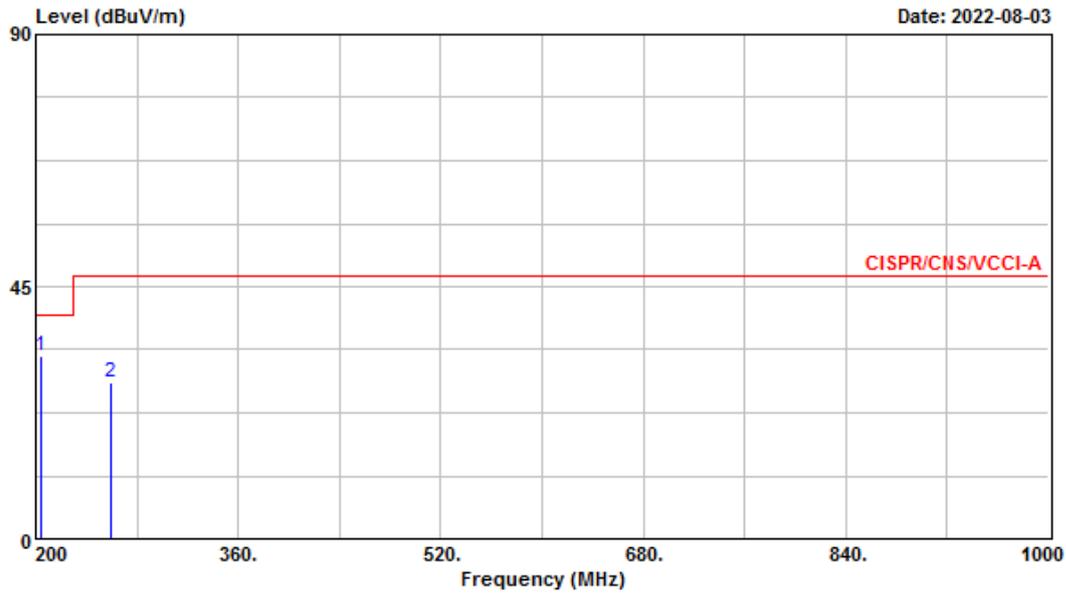
**Horizontal**



	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	80.340	20.06	-19.94	40.00	34.79	12.02	1.70	28.45	Peak	---	---
2	138.990	23.44	-16.56	40.00	33.11	16.42	2.19	28.28	Peak	---	---
3	197.120	32.33	-7.67	40.00	43.18	14.40	2.77	28.02	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	204.800	32.58	-7.42	40.00	43.33	14.40	2.84	27.99	Peak	---	---
2	260.000	27.90	-19.10	47.00	33.74	18.79	3.20	27.83	Peak	---	---

### 4.3. Harmonic Current Emissions Measurement

#### 4.3.1. Limit

Harmonic current emissions evaluate the potential for the EUT to cause distortion on the AC power lines. It is applicable to electrical and electronic equipment having an input current  $\leq 16$  A per phase, and intended to be connected to public low-voltage distribution systems.

Harmonics [n]	Class A [A]	Class B [A]	Class C [% of fund]	Class D [mA/W]
<b>Odd harmonics</b>				
3	2.30	3.45	30 x $\lambda$	3.4
5	1.14	1.71	10	1.9
7	0.77	1.155	7	1.0
9	0.40	0.60	5	0.5
11	0.33	0.495	3	0.35
13	0.21	0.315	3	3.85/13
15 $\leq$ n $\leq$ 39	0.15 x 15/n	0.225 x 15/n	3	3.85/n
<b>Even harmonics</b>				
2	1.08	1.62	2	-
4	0.43	0.645	-	-
6	0.30	0.45	-	-
8 $\leq$ n $\leq$ 40	0.23 x 8/n	0.345 x 8/n	-	-

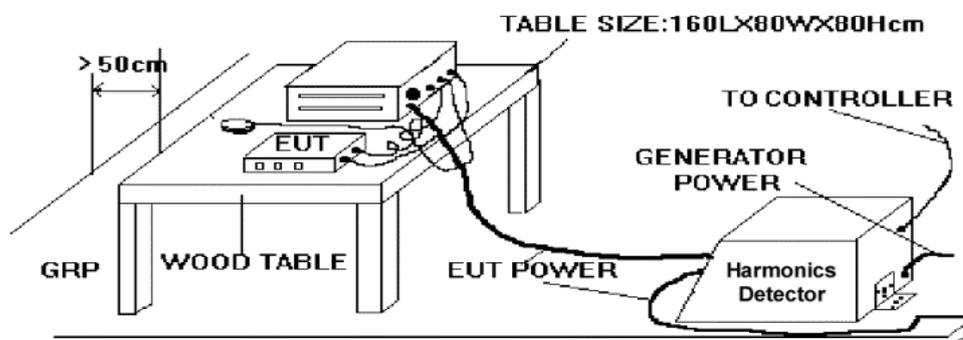
#### 4.3.2. Test Procedure

The test procedures followed are those specified in EN IEC 61000-3-2:2019.

#### 4.3.3. Test Equipment Settings

Harmonic Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Current Measurement Range	High
Measurement Delay	10.0 seconds
Test Duration	10.0 minutes
Class determination Pre-test Duration	10.0 seconds

#### 4.3.4. Typical Test Setup Layout





4.3.5. Test Result

Test mode	Mode 1		
Test Voltage	AC 230V / 50Hz	Device Class	A

Highest parameter values during test:

V RMS (Volts):	229.91	Frequency(Hz):	50.00
I Peak (Amps):	3.242	I RMS (Amps):	2.187
I Fund (Amps):	2.179	Crest Factor:	1.490
Power (Watts):	492.1	Power Factor:	0.979

Harm#	Harms(avg)	100%Limit	%of Limit	Harms(max)	150%Limit	%of Limit	Status
2	0.002	1.080	N/A	0.002	1.620	N/A	Pass
3	0.137	2.300	6.0	0.141	3.450	4.1	Pass
4	0.001	0.430	N/A	0.003	0.645	N/A	Pass
5	0.079	1.140	7.0	0.081	1.710	4.7	Pass
6	0.002	0.300	N/A	0.002	0.450	N/A	Pass
7	0.049	0.770	6.4	0.050	1.155	4.3	Pass
8	0.002	0.230	N/A	0.002	0.345	N/A	Pass
9	0.059	0.400	14.8	0.060	0.600	10.0	Pass
10	0.001	0.184	N/A	0.001	0.276	N/A	Pass
11	0.026	0.330	8.0	0.027	0.495	5.4	Pass
12	0.001	0.153	N/A	0.002	0.230	N/A	Pass
13	0.016	0.210	7.6	0.018	0.315	5.6	Pass
14	0.001	0.131	N/A	0.002	0.197	N/A	Pass
15	0.018	0.150	11.8	0.019	0.225	8.6	Pass
16	0.001	0.115	N/A	0.002	0.173	N/A	Pass
17	0.008	0.132	N/A	0.011	0.198	N/A	Pass
18	0.002	0.102	N/A	0.003	0.153	N/A	Pass
19	0.024	0.118	20.4	0.026	0.178	14.5	Pass
20	0.002	0.092	N/A	0.004	0.138	N/A	Pass
21	0.021	0.107	19.2	0.026	0.161	15.9	Pass
22	0.002	0.084	N/A	0.004	0.125	N/A	Pass
23	0.006	0.098	N/A	0.007	0.147	N/A	Pass
24	0.002	0.077	N/A	0.004	0.115	N/A	Pass
25	0.009	0.090	N/A	0.011	0.135	N/A	Pass
26	0.002	0.071	N/A	0.004	0.107	N/A	Pass
27	0.027	0.083	32.1	0.028	0.125	22.3	Pass
28	0.002	0.066	N/A	0.004	0.099	N/A	Pass
29	0.020	0.078	25.3	0.023	0.116	19.9	Pass
30	0.001	0.061	N/A	0.002	0.092	N/A	Pass
31	0.009	0.073	N/A	0.010	0.109	N/A	Pass
32	0.001	0.058	N/A	0.002	0.086	N/A	Pass
33	0.012	0.068	N/A	0.013	0.102	N/A	Pass
34	0.001	0.054	N/A	0.002	0.081	N/A	Pass
35	0.015	0.064	23.1	0.016	0.096	16.4	Pass
36	0.002	0.051	N/A	0.003	0.077	N/A	Pass
37	0.008	0.061	N/A	0.009	0.091	N/A	Pass
38	0.001	0.048	N/A	0.003	0.073	N/A	Pass
39	0.012	0.058	N/A	0.013	0.087	N/A	Pass
40	0.002	0.046	N/A	0.003	0.069	N/A	Pass

## 4.4. Voltage Fluctuations and Flicker Measurement

### 4.4.1. Limit

The objective of voltage changes, voltage fluctuations and flicker in public low voltage supply systems during equipment with rated current  $\leq 16$  A per phase, ensures that home appliances and certain other electrical equipment do not adversely affect lighting equipment when connected to the same power system.

#### Voltage Fluctuation and Flicker Limits:

- The value of  $P_{st}$  shall not be greater than 1.0.
- The value of  $P_{it}$  shall not be greater than 0.65.
- The value of  $d(t)$  during a voltage change shall not exceed 3.3 % for more than 500 ms.
- The relative steady-state voltage change,  $d_c$ , shall not exceed 3.3 %.
- The maximum relative voltage change,  $d_{max}$ , shall not exceed 4.0 %.

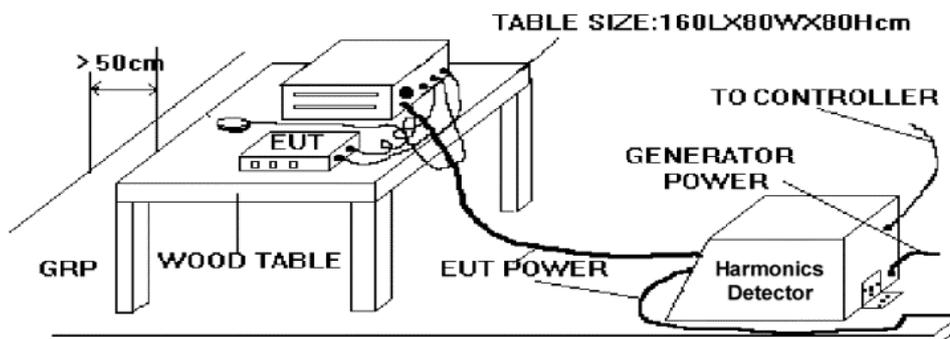
### 4.4.2. Test Procedure

The test procedures followed are those specified in EN 61000-3-3:2013+A1:2019.

### 4.4.3. Test Equipment Settings

Flicker Parameters	Setting
Line Voltage	230 V
Line Frequency	50 Hz
Measurement Delay	10.0 seconds
Pst Integration Time	10.0 minutes
Pst Integration Periods	1
Test Duration	10.0 minutes

### 4.4.4. Typical Test Setup Layout





**4.4.5. Test Result**

<b>Test mode</b>	Mode 1	<b>Test Voltage</b>	AC 230V / 50Hz
------------------	--------	---------------------	----------------

**Parameter values recorded during the test:**

<b>Vrms at the end of test (Volt):</b>	229.88			
<b>T-max (mS):</b>	0	<b>Test limit (mS):</b>	500.0	<b>Pass</b>
<b>Highest dc (%):</b>	0.00	<b>Test limit (%):</b>	3.30	<b>Pass</b>
<b>Highest dmax (%):</b>	0.00	<b>Test limit (%):</b>	4.00	<b>Pass</b>
<b>Highest Pst (10 min. period):</b>	0.218	<b>Test limit:</b>	1.000	<b>Pass</b>



## 5. Immunity Measurement

### 5.1. General performance criteria

<b>Applicable Standard: EN 55035</b>	
<b>Criteria A</b>	The equipment shall continue to operate as intended without operator intervention. No degradation of performance, loss of function or change of operating state is allowed below a performance level specified by the manufacturer when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.
<b>Criteria B</b>	During the application of the disturbance, degradation of performance is allowed. However, no unintended change of actual operating state or stored data is allowed to persist after the test. After the test, the equipment shall continue to operate as intended without operator intervention; no degradation of performance or loss of function is allowed, below a performance level specified by the manufacturer, when the equipment is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level (or the permissible performance loss), or recovery time, is not specified by the manufacturer, then either of these may be derived from the product description and documentation, and by what the user may reasonably expect from the equipment if used as intended.
<b>Criteria C</b>	Loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls by the user in accordance with the manufacturer's instructions. A reboot or re-start operation is allowed. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.



## 5.2. Electrostatic Discharge (ESD)

### 5.2.1. Test Specification

<b>Reference Standard</b>	IEC 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

### 5.2.2. Test Levels

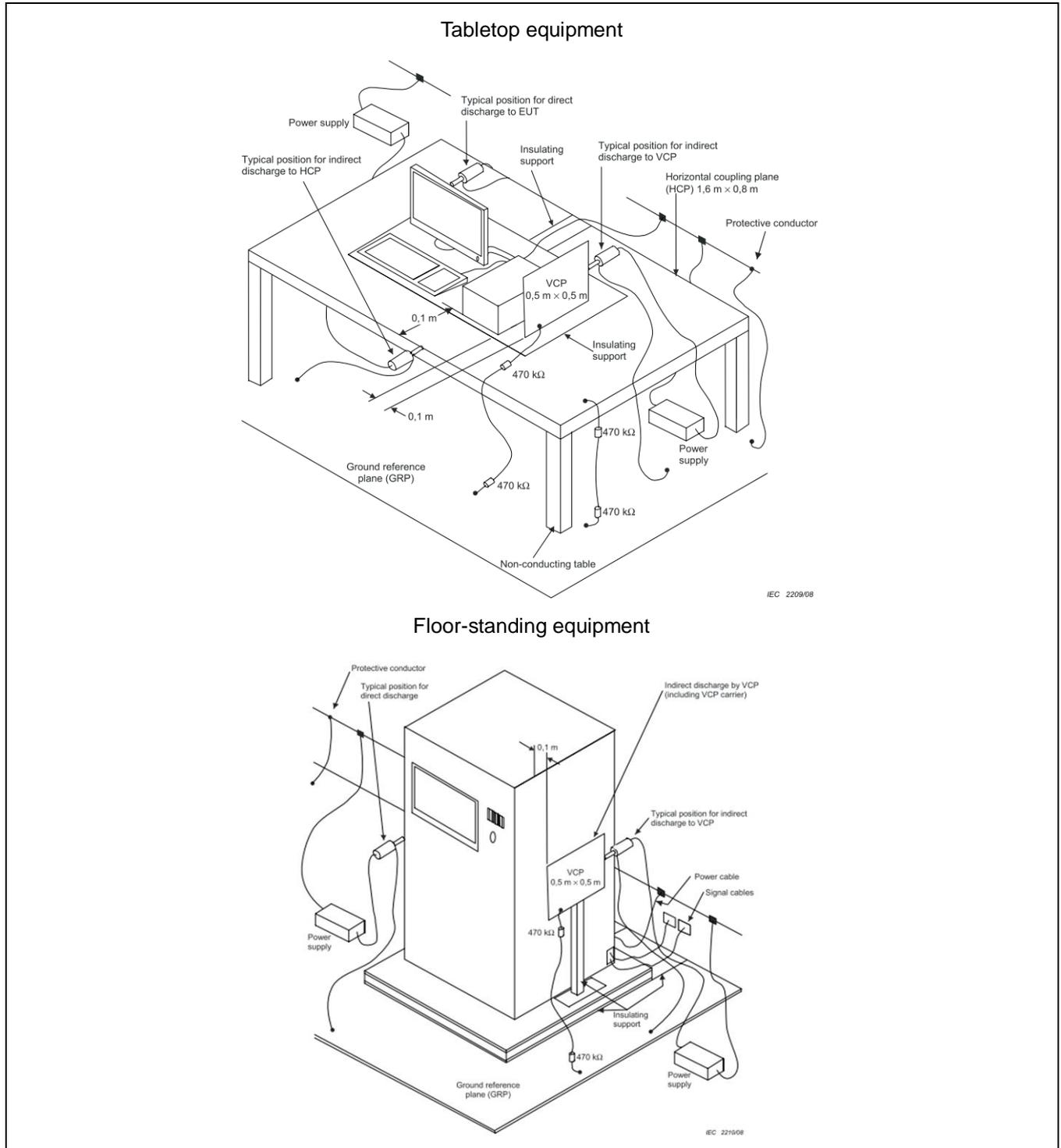
Contact discharge		Air Discharge	
Level	Test Voltage kV	Level	Test Voltage kV
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15
x	Specified	x	Specified

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.

### 5.2.3. 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.

**5.2.4. Test Setup**





The test setup consists of the test generator, EUT and auxiliary instrumentation necessary to perform DIRECT and INDIRECT application of discharges to the EUT as applicable, in the follow manner:

- a). CONTACT DISCHARGE to the conductive surfaces and to coupling plane;
- b). AIR DISCHARGE at insulating surfaces.

The preferred test method is that of type tests performed in laboratories and the only accepted method of demonstrating conformance with this standard. The EUT was arranged as closely as possible to arrangement in final installed conditions.

### 5.2.5. 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

**5.2.6. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<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**

Test Point	No. of Disch.	Test Result (Criteria)		Remark
		+8kV	-8kV	
3	10	A	A	-

Remark: (N/D): No Discharge..

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

Test Point	No. of Disch.	Test Result (Criteria)		Remark
		+4kV	-4kV	
1	25	A	A	-
2	25	A	A	-

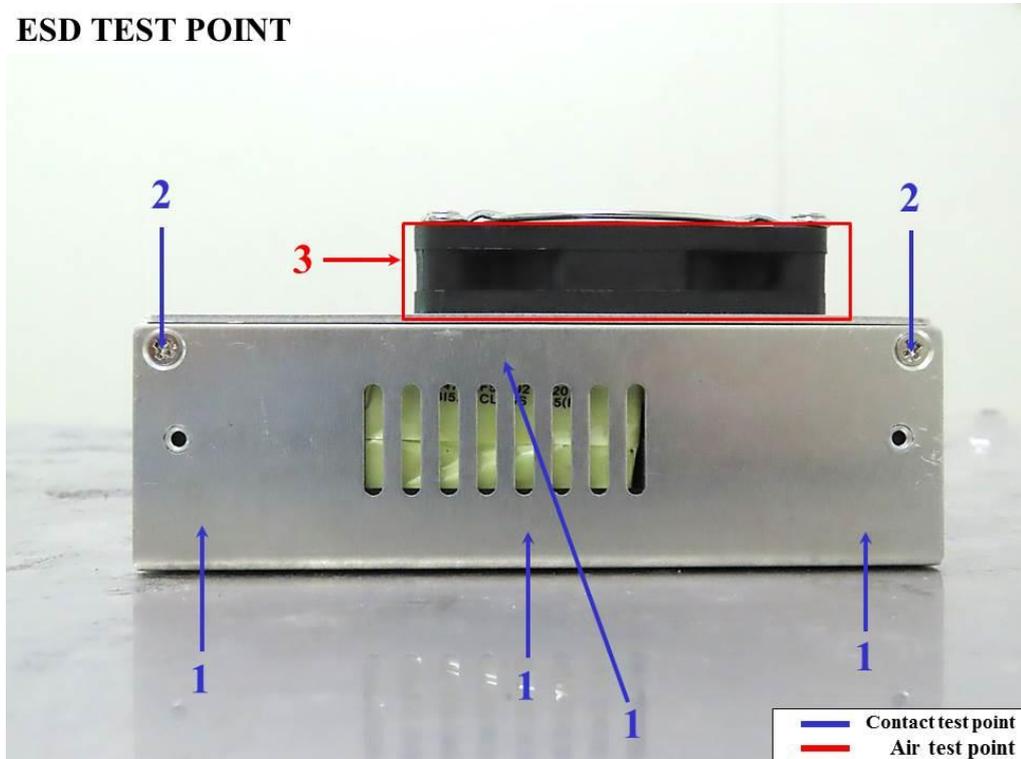
**Indirect discharge to HCP and VCP**

Test Point	No. of Disch.	Test Result (Criteria)		Remark
		+4kV	-4kV	
HCP (At Front)	25	A	A	-
HCP (At Left)	25	A	A	-
HCP (At Right)	25	A	A	-
HCP (At Rear)	25	A	A	-
VCP (At Front)	25	A	A	-
VCP (At Left)	25	A	A	-
VCP (At Right)	25	A	A	-
VCP (At Rear)	25	A	A	-

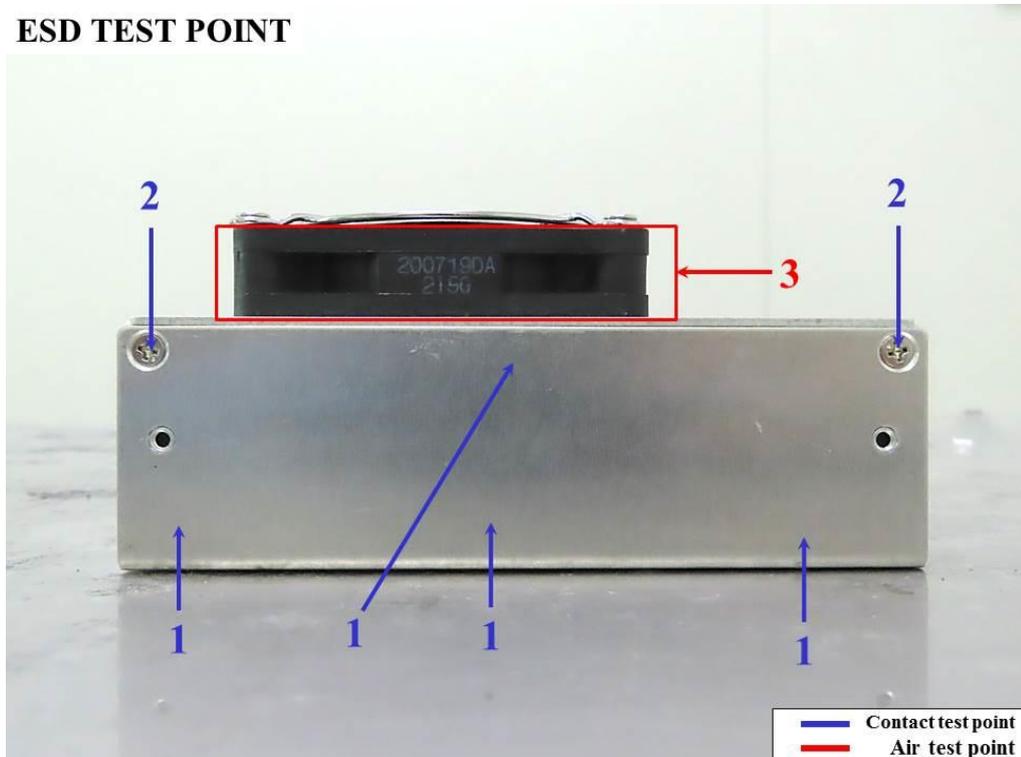
Note: According to manufacturer requirements, during the test, 25 times of each polarity.

**5.2.7. Photographs of Electrostatic Discharge Immunity Test**

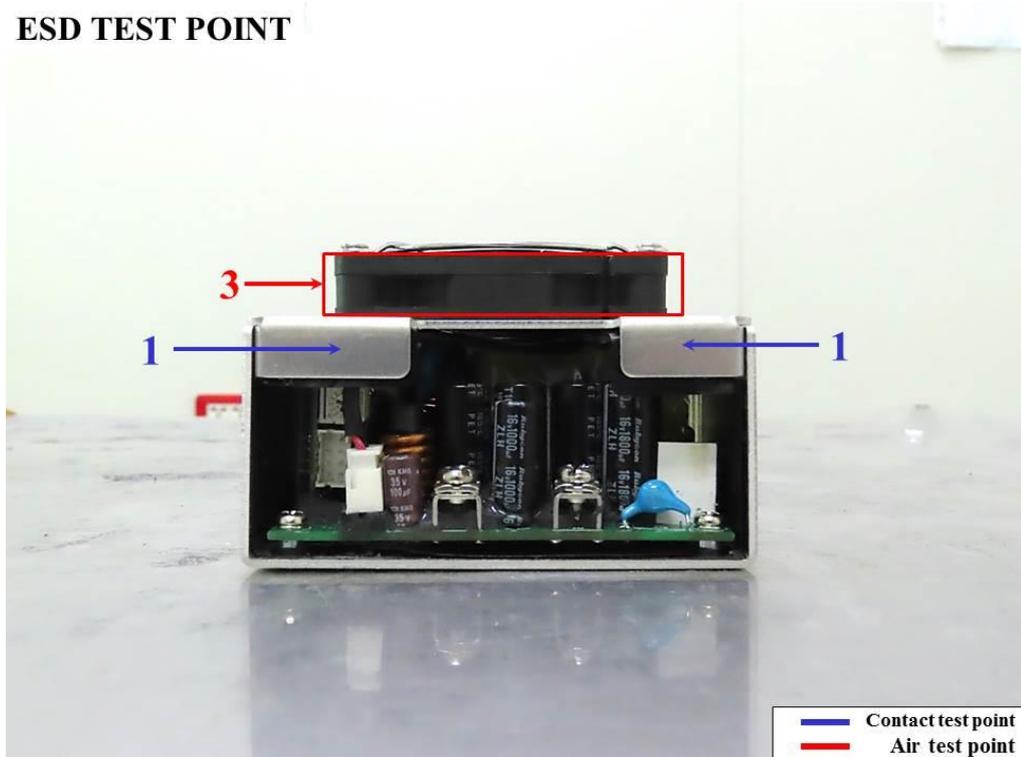
Test Points      **ESD TEST POINT**



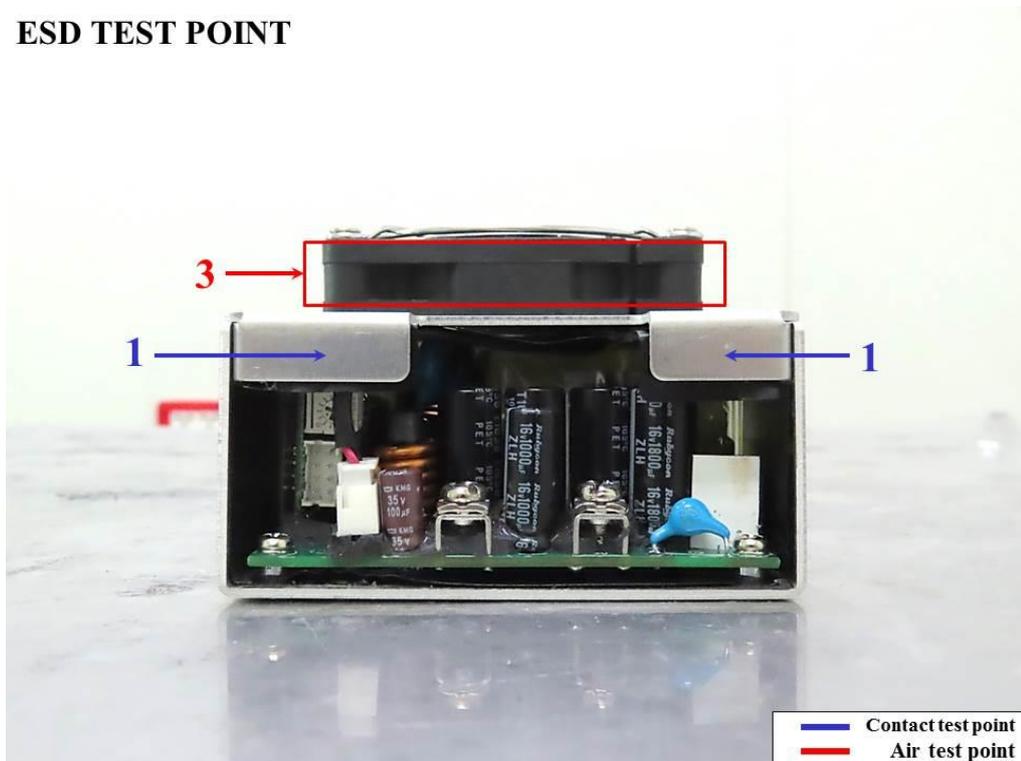
**ESD TEST POINT**



Test Points **ESD TEST POINT**

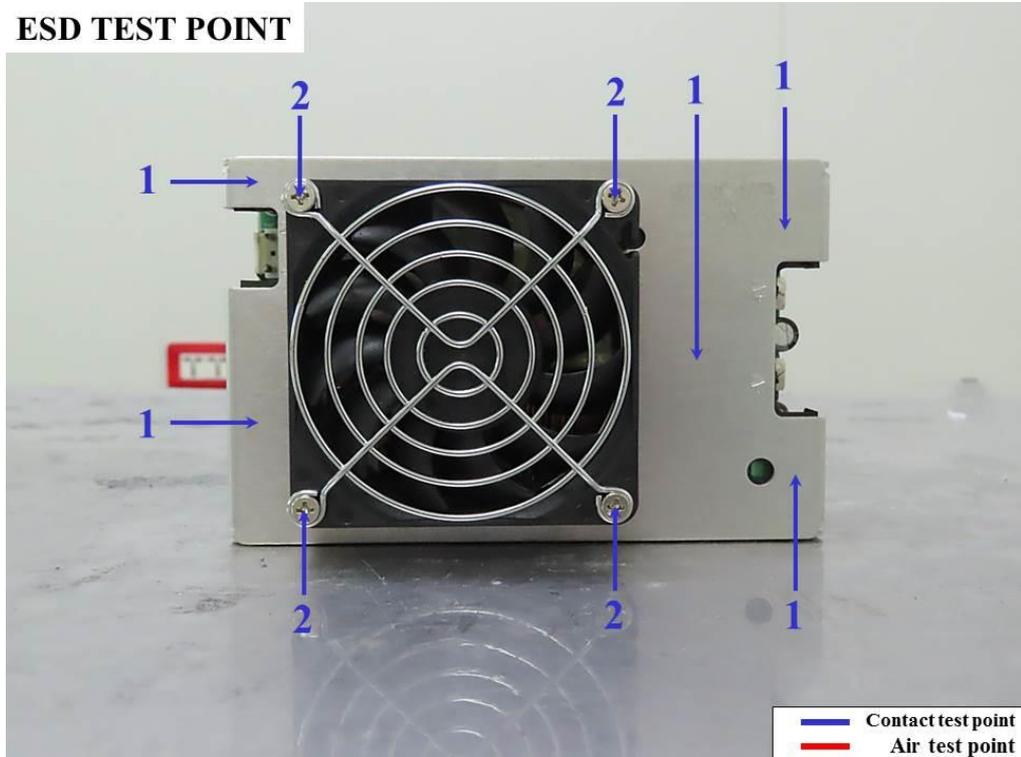


**ESD TEST POINT**



Test Points

ESD TEST POINT





5.3. Radio Frequency Electromagnetic Field (RS)

5.3.1. Test Specification

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

5.3.2. Test Levels

Level	Test field strength V/m
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.

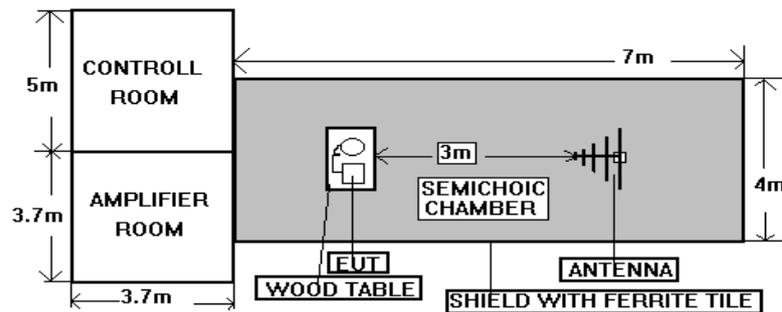
If the audio output function needs to be test, the function should be maintained and the following requirements should be met

Performance criterion A – Limits for devices supporting telephony					
Type of immunity test	Frequency range MHz	Acoustic or electrical interference ratio	Equivalent direct measurement		
			dB(SPL)	Digital dBm0	Analogue dBm
Radiated	80 to 1,000	0dB	75	-30	-30
<p>The equivalent direct measurement values are presented to show the equivalency of the interference ratio in comparison to a direct measured value. These values may be used if the direct measurement method of the test is used.</p> <p>The values within this table are aligned with CISPR 24, noting that the test levels are different between this document and CISPR 24.</p> <p>For terminals connected to digital wired network ports (such as Ethernet, ISDN), measurements of the demodulated 1 kHz may be performed on a remote AE, ideally of the same design.</p>					
MME not supporting telephony reference level					
<p>A level within the expected dynamic range of the audio output, as intended by the manufacturer and is: at least 10 dB below the highest peak reproduced audio level occurring in normal use; and, below the highest level of reproduced audio that can be continuously output in normal use.</p> <p>The measured acoustic interference ratio and/or the measured electrical interference ratio during the test shall be -20 dB or better.</p>					

**5.3.3. Test Procedure**

- a). 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.
- b). 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 5000 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.
- c). 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.
- d). 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.
- e). At each of the above conditions, the frequency range is swept 80 to 5000 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.

**5.3.4. 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.

**5.3.5. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Frequency Range(swept)</b>	80 to 1000 MHz		
<b>Frequency Range(spot)</b>	1800,2600,3500,5000 MHz ( $\pm 1\%$ )		
<b>Electromagnetic field</b>	3 V/m (unmodulated, r.m.s)		
<b>Amplitude modulated</b>	80% AM (1 kHz)		
<b>Performance Criteria</b>	A		

Frequency Range MHz	Test field strength V/m	Antenna Polarization	Azimuth Degree	Test Result (Criteria)	Remark
80~1000	3	V&H	0, 90, 180, 270	A	-
1800	3	V&H	0, 90, 180, 270	A	-
2600	3	V&H	0, 90, 180, 270	A	-
3500	3	V&H	0, 90, 180, 270	A	-
5000	3	V&H	0, 90, 180, 270	A	-



5.4. Electrical Fast Transient/Burst (EFT/B)

5.4.1. Test Specification

Reference Standard	IEC 61000-4-4
Polarity	positive/negative
Repetition Rate	1 time / minute

5.4.2. Test Levels

Open circuit output test voltage and repetition frequency of the impulses				
Level	Power ports, earth port (PE)		Signal and control ports	
	Voltage peak kV	Repetition frequency kHz	Voltage peak kV	Repetition frequency kHz
1	0.5	5 or 100	0.25	5 or 100
2	1	5 or 100	0.5	5 or 100
3	2	5 or 100	1	5 or 100
4	4	5 or 100	2	5 or 100
X	Specified	Specified	Specified	Specified

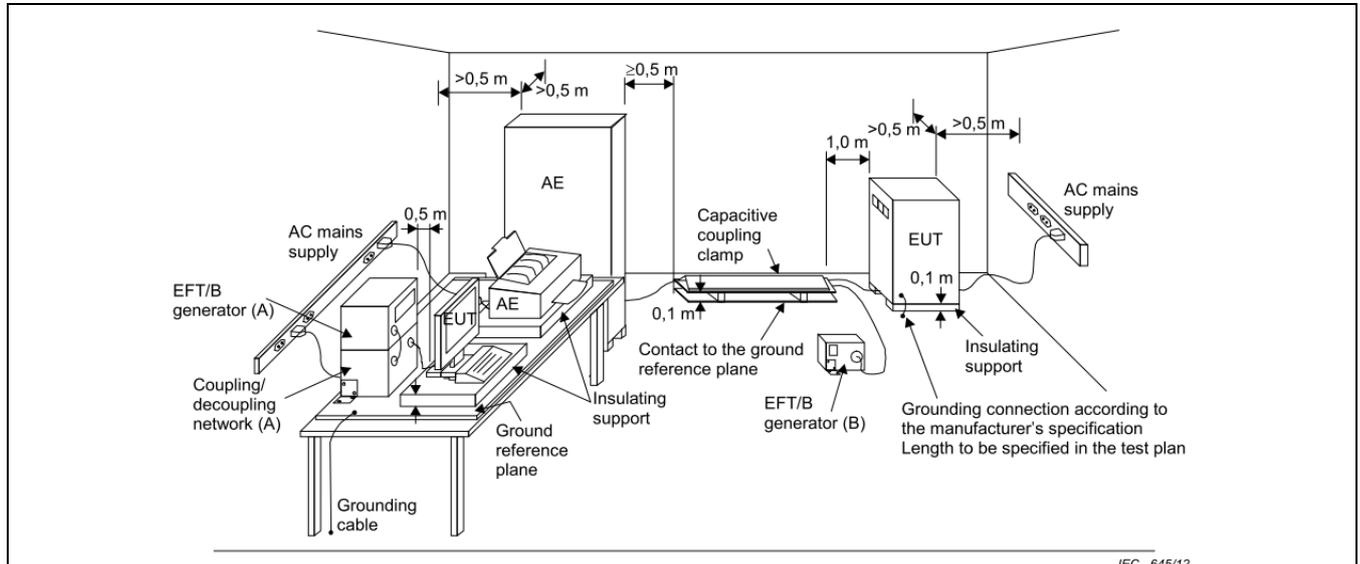
The use of 5 kHz repetition frequency is traditional, however, 100 kHz is closer to reality. Product committees should determine which frequencies are relevant for specific products or product types. With some products, there may be no clear distinction between power ports and signal ports, in which case it is up to product committees to make this determination for test purposes.

Remark : " x " can be any level, above, below or in between the others. The level shall be specified in the dedicated equipment specification.

5.4.3. Test Procedure

- a). In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.
- b). The variety and diversity of equipment and systems to be tested make it difficult to establish general criteria for the evaluation of the effects of fast transients/bursts on equipment and systems.
- c). The test results may be classified on the basic of the operating conditions and the functional specification of the equipment under test, according to the following performance criteria :
  - Normal performance within the specification limits.
  - Temporary degradation or loss of function or performance which is self-recoverable.
  - Temporary degradation or loss of function or performance which requires operator intervention or system reset.
  - Degradation or loss of function which is not recoverable due to damage of equipment (components).

**5.4.4. Test setup**



- (A) location for supply line coupling
- (B) location for signal lines coupling

The EUT was placed on a ground reference plane and was insulated from it by an insulating support about 0.1 m thick. If the EUT is table-top equipment, it was located approximately 0.8 m above the GRP. The GRP. 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. It shall project beyond the EUT by at least 0.1 m on all sides and connected to the protective earth. 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. The minimum distance between the EUT and other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. using the coupling clamp, the minimum distance between the coupling plates and all other conductive structures, except the GRP. Beneath the EUT, was more than 0.5 m. The length of the signal and power lines between the coupling device and the EUT was 0.5 m or less.

**5.4.5. Test on Power Line**

- a). The EFT/B-generator was located on the GRP. The length from the EFT/B-generator to the EUT as not exceeds 0.5 m.
- b). The EFT/B-generator provides the ability to apply the test voltage in a non-symmetrical condition to the power supply input terminals of the EUT.

**5.4.6. Test on Communication Lines**

- a). The coupling clamp is composed of a clamp unit for housing the cable (length more than 3 m), and was placed on the GRP.
- b). The coupling clamp provides the ability of coupling the fast transient/bursts to the cable under test.

**5.4.7. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Test Voltage</b>	Input AC power ports: 1.0 kV		
<b>Impulse wave shape</b>	5/50 ns (Tr/Th)		
<b>Repetition frequency</b>	5 kHz		
<b>Performance Criteria</b>	B		

**Test Result - Input a.c. power ports:**

Test Location	Test Voltage kV	Test Result (Criteria)		Remark
		pos. (+)	neg. (-)	
L+N+PE	1.0	A	A	-

Remark : PE = Earth reference



### 5.5. Surges

#### 5.5.1. Test Specification

<b>Reference Standard</b>	IEC 61000-4-5
<b>Polarity</b>	positive/negative
<b>Phase Angle</b>	90°, 270° (AC power port)
<b>Number of surges</b>	5 positive and 5 negative pulses
<b>Test Repetition Rate</b>	1 time / minute

#### 5.5.2. Test Levels

Level	Open-circuit test voltage	
	kV	
	Line-to-line	Line-to-ground *
1	-	0.5
2	0.5	1.0
3	1.0	2.0
4	2.0	4.0
x	Specified	Specified

Remark : " x " can be any level, above, below or in between the others. The level shall be specified in the dedicated equipment specification.

" \* "For symmetrical interconnection lines the test can be applied to multiple lines simultaneously with respect to ground, i.e. "lines to ground".



**5.5.3. Test Procedure**

- a). Electromagnetic conditions:  
The electromagnetic environment of the laboratory shall not influence the test results.
- b). The test shall be performed according the test plan that shall specify the test set-up with
  - generator and other equipment utilized;
  - test level ( voltage/current );
  - generator source impedance;
  - internal or external generator trigger;
  - number of tests : at least five positive and five negative at the selected points;
  - repetition rate : maximum 1/min.
  - inputs and outputs to be tested;
  - representative operating conditions of the EUT;
  - sequence of application of the surge to the circuit;
  - phase angle in the case of a.c. power supply;
  - actual installation conditions, for example:  
AC : neutral earthed,  
DC : ( + ) or ( - ) earthed to simulated the actual earthing conditions.
- c). If not otherwise specified the surges have to be applied synchronized to the voltage phase at the zero-crossing and the peak value of the a.c. voltage wave ( positive and negative ).
- d). The surges have to be applied line to line and line(s) and earth. When testing line to earth, the test voltage has to be applied successively between each of the lines and earth, if there is no other specification.
- e). The test procedure shall also consider the non-linear current-voltage characteristics of the equipment under test. Therefore the test voltage has to be increased by steps up to the test level specified in the product standard or test plan.
- f). All lower levels including the selected test level shall be satisfied. For testing the secondary protection, the output voltage of the generator shall be increased up to the worst-case voltage breakdown level ( let-through level ) of the primary protection.
- g). If the actual operating signal sources are not available, they may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according the test plan.
- h). To find all critical points of the duty cycle of the equipment, a sufficient number of positive and negative test pulses shall be applied. For acceptance test previously unstressed equipment shall be used to the protection devices shall be replaced.

**5.5.4. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Test Voltage</b>	Input AC power ports: line to line: 1.0 kV; line to earth or ground: 2.0 kV		
<b>Impulse wave shape</b>	Input a.c. power ports: 1,2/50 ( 8/20 ) Tr/Th $\mu$ s		
<b>Performance Criteria</b>	Input a.c. power ports: B		

**Test Result - Input a.c. power ports:**

Test Location	Test Voltage kV	Polarity pos. / neg.	Test Result (Criteria)		Remark
			Phase Angle (Degree)		
			90°	270°	
L - N	1.0	+ / -	A	A	-
L - PE	2.0	+ / -	A	A	-
N - PE	2.0	+ / -	A	A	-

Remark : PE = Earth reference



5.6. Conducted Disturbances Induced by Radio-Frequency Field (CS)

5.6.1. Test Specification

Reference Standard	IEC 61000-4-6
Dwell Time	2.9 seconds
Frequency Step size	1 % of the preceding frequency value

5.6.2. Test Levels

Frequency range 150 kHz – 80 MHz		
Level	Voltage level (e.m.f.)	
	$U_0$ dB( $\mu$ V)	$U_0$ V
1	120	1
2	129.5	3
3	140	10
x	Specified	

Remark : " x " is an open level.

If the audio output function needs to be test, the function should be maintained and the following requirements should be met

Performance criterion A – Limits for devices supporting telephony					
Type of immunity test	Frequency range MHz	Acoustic or electrical interference ratio	Equivalent direct measurement		
			dB(SPL)	Digital dBm0	Analogue dBm
Conducted <sup>a</sup>	0,15 to 30	-20 dB	55	-50	-50
	30 to 80	-10 dB	65	-40	-40

<sup>a</sup> At the step in the frequency range, the lower limit shall be applied.  
 The equivalent direct measurement values are presented to show the equivalency of the interference ratio in comparison to a direct measured value. These values may be used if the direct measurement method of the test is used.  
 The values within this table are aligned with CISPR 24, noting that the test levels are different between this document and CISPR 24.  
 For terminals connected to digital wired network ports (such as Ethernet, ISDN), measurements of the demodulated 1 kHz may be performed on a remote AE, ideally of the same design.

MME not supporting telephony reference level

A level within the expected dynamic range of the audio output, as intended by the manufacturer and is: at least 10 dB below the highest peak reproduced audio level occurring in normal use; and, below the highest level of reproduced audio that can be continuously output in normal use.  
 The measured acoustic interference ratio and/or the measured electrical interference ratio during the test shall be -20 dB or better.



**5.6.3. Test Procedure**

- a). The EUT shall be operated within its intended climatic conditions. The temperature and relative humidity should be recorded.
- b). This test method test can be performed without using a sell shielded enclosure. This is because the disturbance levels applied and the geometry of the setups are not likely to radiated a high amount of energy, especially at the lower frequencies. If under certain circumstances the radiated energy is too high, a shielded enclosure has to be used.
- c). The test shall be performed with the test generator connected to each of the coupling and decoupling devices in turn while the other non-excited RF-input ports of the coupling devices are terminated by a 50 ohm load resistor.
- d). The frequency range is swept from 150 kHz to 80 MHz, using the signal levels established during the setting process, and with the disturbance signal 80% amplitude modulated with a 1kHz sine wave, pausing to adjust the RF-signal level or to switch coupling devices as necessary. The rate of sweep shall no exceed  $1.5 \times 10^{-3}$  decades/s. Where the frequency is swept incrementally, the step size shall no exceed 1% of the start and thereafter 1% of the preceding frequency value.
- e). 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.
- f). In cases of dispute, the test procedure using a step size not exceeding 1% of the start and thereafter 1% of preceding frequency value shall take precedence.
- g). Attempts should be made to fully exercise the EUT during testing, and to fully interrogate all exercise modes selected for susceptibility.
- h). The use of special exercising programs is recommended.
- i). Testing shall be performed according to a Test Plan, which shall be included in the test report.
- j). It may be necessary to carry out some investigatory testing in order to establish some aspects of the test plan.

**5.6.4. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Frequency Range</b>	0.15 to 80 MHz (For applicant Requirement)		
<b>Test Voltage</b>	3 V (For applicant Requirement)	unmodulated, r.m.s	
<b>Amplitude modulated</b>	80% AM (1 kHz)		
<b>Performance Criteria</b>	A		

<b>Frequency Range</b> MHz	<b>Test Voltage</b> V rms	<b>CDN</b>	<b>Test Port</b>	<b>Test Result</b> <b>(Criteria)</b>	<b>Remark</b>
0.15 ~ 80	3	CDN-M016 SW M3	Input power port(AC)	A	-



## 5.7. Power Frequency Magnetic Field (PFMF)

### 5.7.1. Test Specification

Reference Standard	IEC 61000-4-8
Frequency Range	50 or 60 Hz
Inductance Coil	1 m x 1 m

### 5.7.2. Test Levels

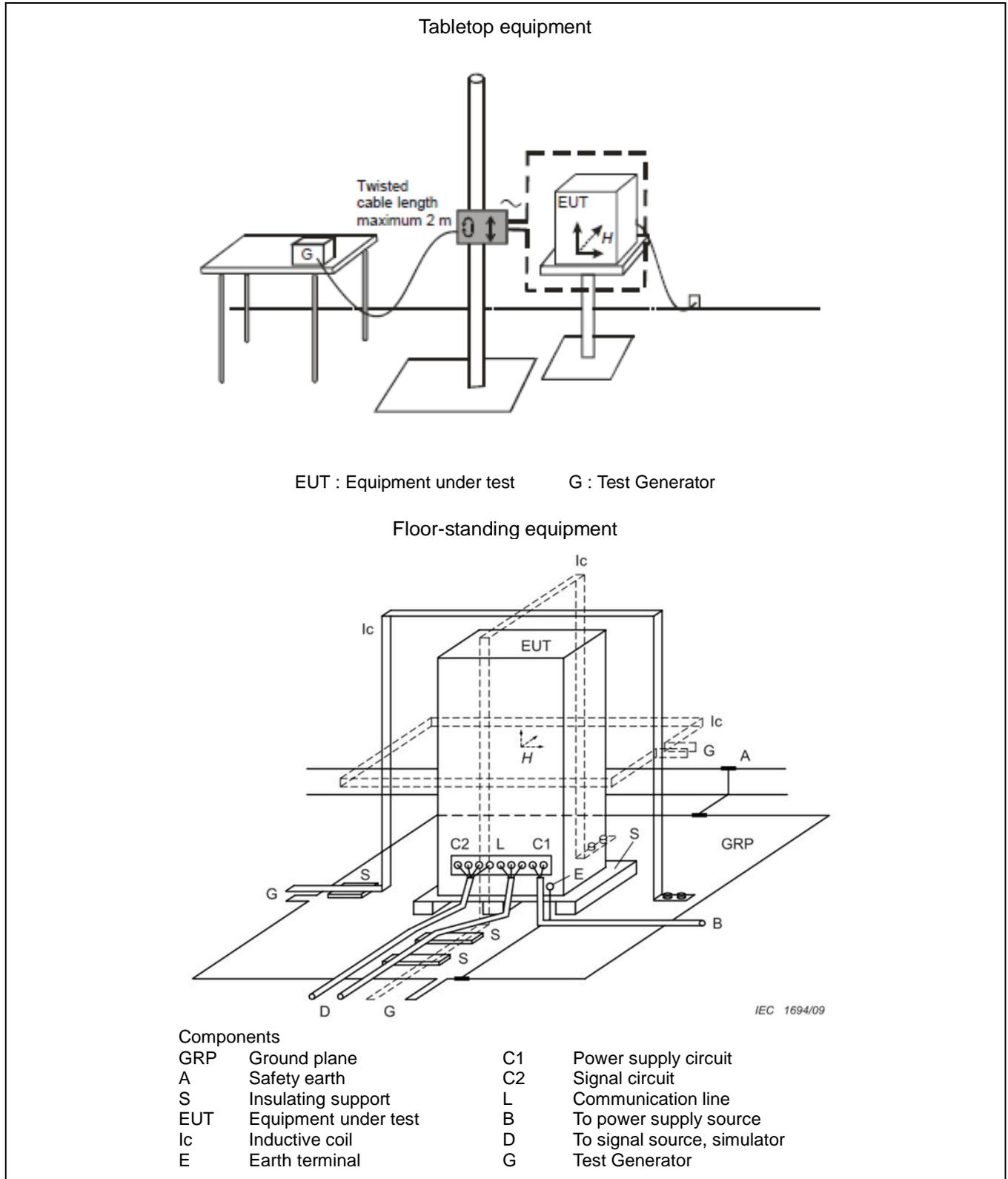
Level	Magnetic field strength A/m
1	1
2	3
3	10
4	30
5	100
x	Specified

Remark : " x " can be any level, above, below or in-between the other levels. This level can be given in the product specification.

### 5.7.3. Test Procedure

- The equipment is configured and connected to satisfy its functional requirements.
- The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.
- The cables supplied or recommended by the equipment manufacturer shall be used. 1 meter of all cables used shall be exposed to the magnetic field.

**5.7.4. Test Setup**





**5.7.5. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Power-frequency</b>	50 Hz	<b>Magnetic field</b>	1 A/m (r.m.s.)
<b>Performance Criteria</b>	A		

<b>Power Frequency Magnetic Field</b>	<b>Testing duration</b>	<b>Coil Orientation</b>	<b>Test Result (Criteria)</b>	<b>Remark</b>
50Hz, 1A/m	1.0 Min	X-axis	A	-
50Hz, 1A/m	1.0 Min	Y-axis	A	-
50Hz, 1A/m	1.0 Min	Z-axis	A	-



## 5.8. Voltage Dips and Voltage Interruptions (DIPs)

### 5.8.1. Test Specification

<b>Reference Standard</b>	IEC 61000-4-11
<b>Phase shifting</b>	0° / 180°
<b>Test of interval</b>	10 sec
<b>Level and duration</b>	Sequence of 3 dips/interrupts
<b>Voltage rise (and fall) time</b>	1 ~ 5 $\mu$ s

### 5.8.2. Test Levels

The voltages in this standard use the rated voltage for the equipment ( $U_T$ ) as a basis for voltage test level specification.

Where the equipment has a rated voltage range the following shall apply:

- if the voltage range does not exceed 20 % of the lower voltage specified for the rated voltage range, a single voltage within that range may be specified as a basis for test level specification ( $U_T$ );
- in all other cases, the test procedure shall be applied for both the lowest and highest voltages declared in the voltage range;

### 5.8.3. Testing Requirement and Procedure

The test was based on IEC 61000-4-11.

**5.8.4. Test Result**

<b>Test mode</b>	Mode 1		
<b>Applicable Standard</b>	EN 55035:2017+A11:2020	<b>Final Test Result</b>	<b>PASS</b>
<b>Voltage dips</b>	<5% residual; 0,5 period		
	70% residual; 25 periods for 50Hz; 30 periods for 60Hz		
<b>Voltage interruptions</b>	<5% residual; 250 periods for 50Hz; 300 periods for 60Hz		
<b>Performance Criteria</b>	B/C/C		

**Test Result of 100V/50Hz**

Test Voltage ( V )	Residual Voltage	Duration (Periods)	Test Result (Criteria)		Remark
			(Phase Angle)		
			0°	180°	
100	< 5 %	0.5	A	A	-
100	70 %	25	A	A	-
100	< 5 %	250	<b>B</b>	<b>B</b>	<b>Note<sup>1</sup></b>
<b>Note<sup>1</sup></b>	After the interruption. The Power of EUT self-recoverable				

**Test Result of 240V/50Hz**

Test Voltage ( V )	Residual Voltage	Duration (Periods)	Test Result (Criteria)		Remark
			(Phase Angle)		
			0°	180°	
240	< 5 %	0.5	A	A	-
240	70 %	25	A	A	-
240	< 5 %	250	<b>B</b>	<b>B</b>	<b>Note<sup>1</sup></b>
<b>Note<sup>1</sup></b>	After the interruption. The Power of EUT self-recoverable				



## 6. 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)).

### 6.1. Measurement Uncertainty

Test Items	Test Site No.	$U_{LAB}$
Conducted Emissions (AMN)	CO04-HY	2.64 dB
Radiated Emissions below 1GHz	OS03-NH	5.07 dB



## 7. List of Measuring Equipment Used

### Conducted Emission - Test Date: 10/Aug/2022

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
EMI Test Receiver	R&S	ESR	102051	9kHz ~ 3.6GHz	13/May/2022	12/May/2023	Conduction (CO04-HY)
Two-Line V-Network	R&S	ENV 216	100003	9kHz ~ 30MHz	18/Feb/2022	17/Feb/2023	Conduction (CO04-HY)
RF Cable 5m	TITAN	RG142	CO04-cable-01	9 kHz~200MHz	01/Mar/2022	28/Feb/2023	Conduction (CO04-HY)
Impuls Begrenzer Pulse Limiter	SCHWARZBEC K	VTSD 9561-F	9561-F041	9kHz ~ 30MHz	26/Oct/2021	25/Oct/2022	Conduction (CO04-HY)
Software	Sporton	SENSE-EMI	V5.10.8	-	NCR	NCR	Conduction (CO04-HY)

NCR: No Calibration Required

### Radiated Emission below 1GHz - Test Date: 03/Aug/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	06/Jul/2022	05/Jul/2023	Radiation (OS03-NH)
Receiver	R&S	ESCI	100497	9 kHz - 3 GHz	12/May/2022	11/May/2023	Radiation (OS03-NH)
Bilog Antenna With 5dB Attenuator	CHASE	CBL6112D	25234	30 MHz - 2 GHz	23/Apr/2022	22/Apr/2023	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	12/Jul/2022	11/Jul/2023	Radiation (OS03-NH)
Software	Audix	E3	Ver.4	-	NCR	NCR	Radiation (OS03-NH)

NCR: No Calibration Required



**EMS - Test Date: 11/Aug/2022 ~ 24/Sep/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
Advanced EMC Immunity Test System	KeyTek	EMCPro	0609221	0 kV - 4.4 kV, 0 kV -6 kV/2Ω, 230VA/50Hz/60Hz	07/Sep/2022	06/Sep/2023	EFT
Software	KetTek	CEWare32	Version 4.1	-	NCR	NCR	EFT
Advanced EMC Immunity Test System	KeyTek	EMCPro	609221	0 kV - 4.4 kV, 0 kV -6 kV/2Ω, 230VA/50Hz/60Hz	07/Sep/2022	06/Sep/2023	Surge
Software	KetTek	CEWare32	Version 4.1	-	NCR	NCR	Surge
EMC Immunity test System	TESEQ	NSG 4070B-35	42289	9kHz ~ 1GHz	25/Aug/2022	24/Aug/2023	CS
Attenuator	Bird	75-A-FFN-06	1732	150kHz ~ 230MHz	24/Aug/2022	23/Aug/2023	CS
Coupling and Decoupling Network	TESEQ	CDN M016	25103	150kHz ~ 230MHz	10/Nov/2021	09/Nov/2022	CS
Software	TESEQ	NSG4070	Version(1.2.0)	-	NCR	NCR	CS
Magnetic field Immunity system	FCC (KEYTEK)	F-1000-4-8-G-12 5A,F-1000-4-8/9 /10-L-1AM	05004, 03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	26/Oct/2021	25/Oct/2022	Magnetic
Advanced EMC Immunity Test System	KeyTek	EMCPro	609221	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	07/Sep/2022	06/Sep/2023	DIP
Software	KetTek	CEWare32	Version 4.1	-	NCR	NCR	DIP
Harmonic/Flicker Test System	TESEQ	CCN1000-1	72471	4000VA 16A PEAK	31/Mar/2022	30/Mar/2023	Harmonic/Flicker
AC Power Source	TESEQ	NSG 1007-5	1510A00144	16A PEAK	31/Mar/2022	30/Mar/2023	Harmonic/Flicker
Software	AMETEK	CTS 4	Version4.29.0	-	NCR	NCR	Harmonic/Flicker

NCR: No Calibration Required

**RS - Test Date: 24/Sep/2022**

Instrument	Manufacturer/ Brand	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date	Remark
Signal Generator	ROHDE&SCHW ARZ	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	SCHWARZBEC K	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	RS01HY	80MHz ~ 6GHz	30/Jun/2022	29/Jun/2023	RS
RF-Switch Network	TESEQ	RFB 2000	45818	N/A	NCR	NCR	RS
Probe	ETS-LINDGREN	HI-6005	00052473	0.1 MHz - 6GHz	02/Sep/2022	01/Sep/2023	RS
Software	Sporton	SENSE-CSRS	V5.10.4	-	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

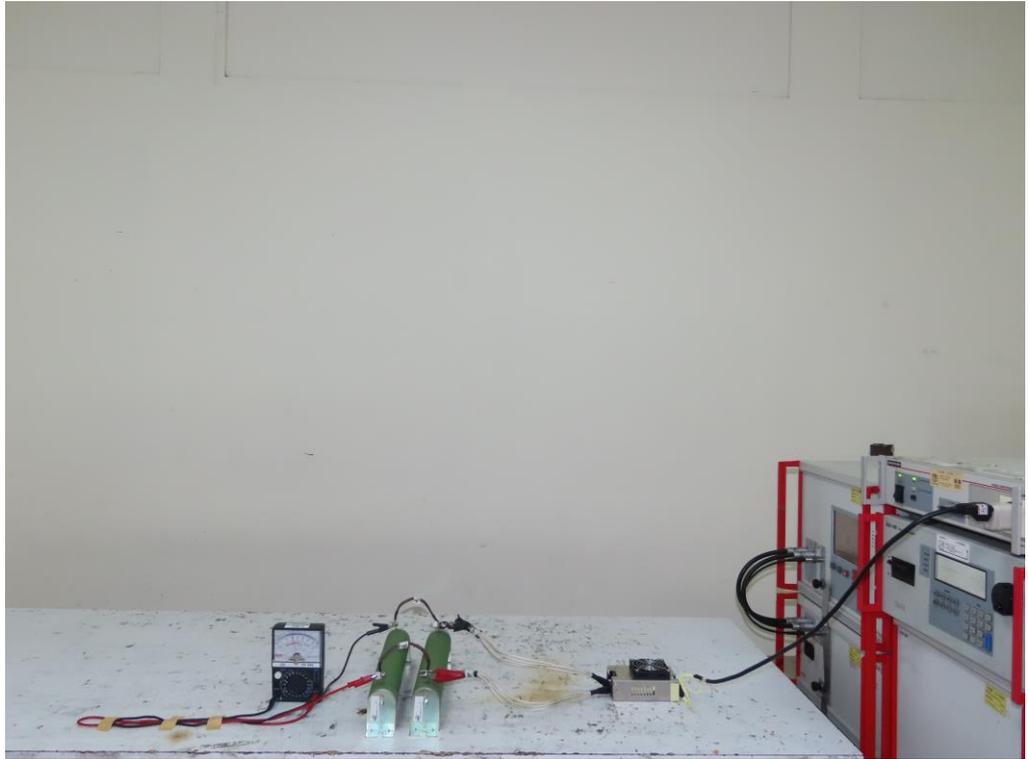


Rear View



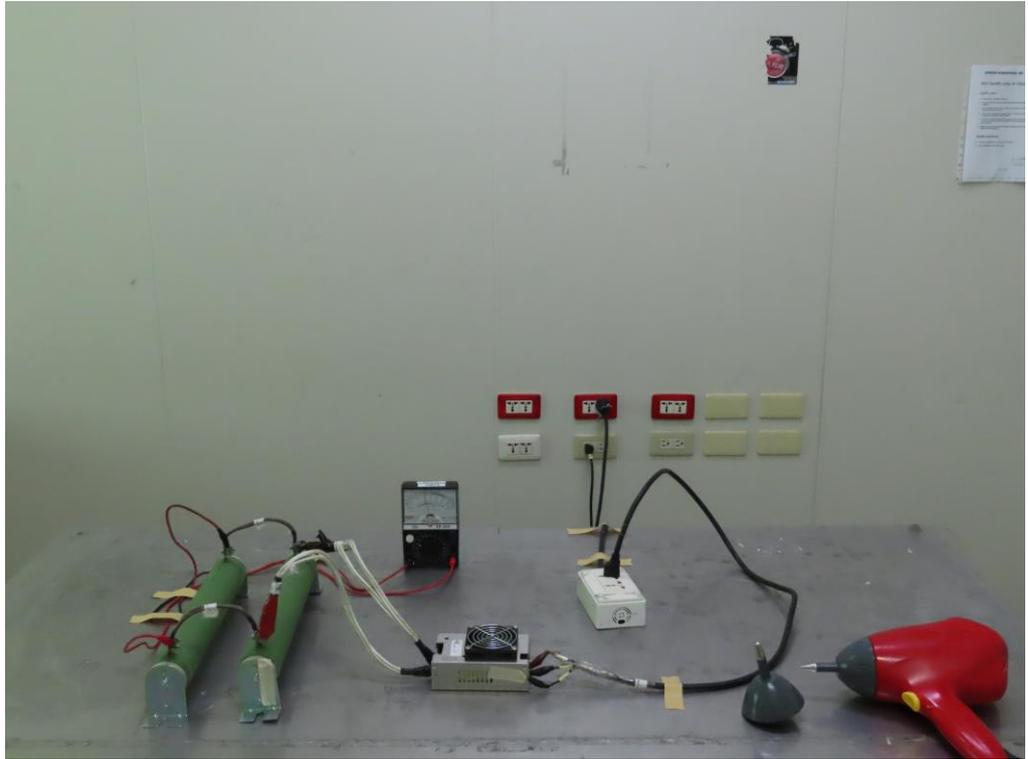
### 3. Photographs of Harmonic, Flicker Test Configuration

Front View



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

Front View

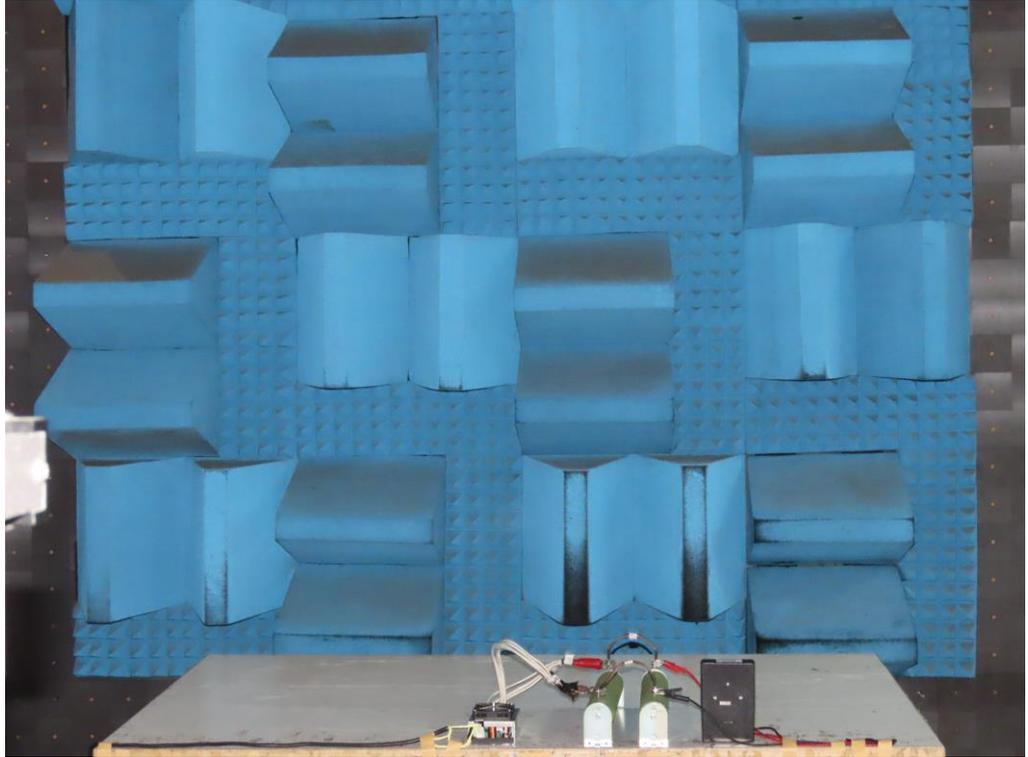


Rear View

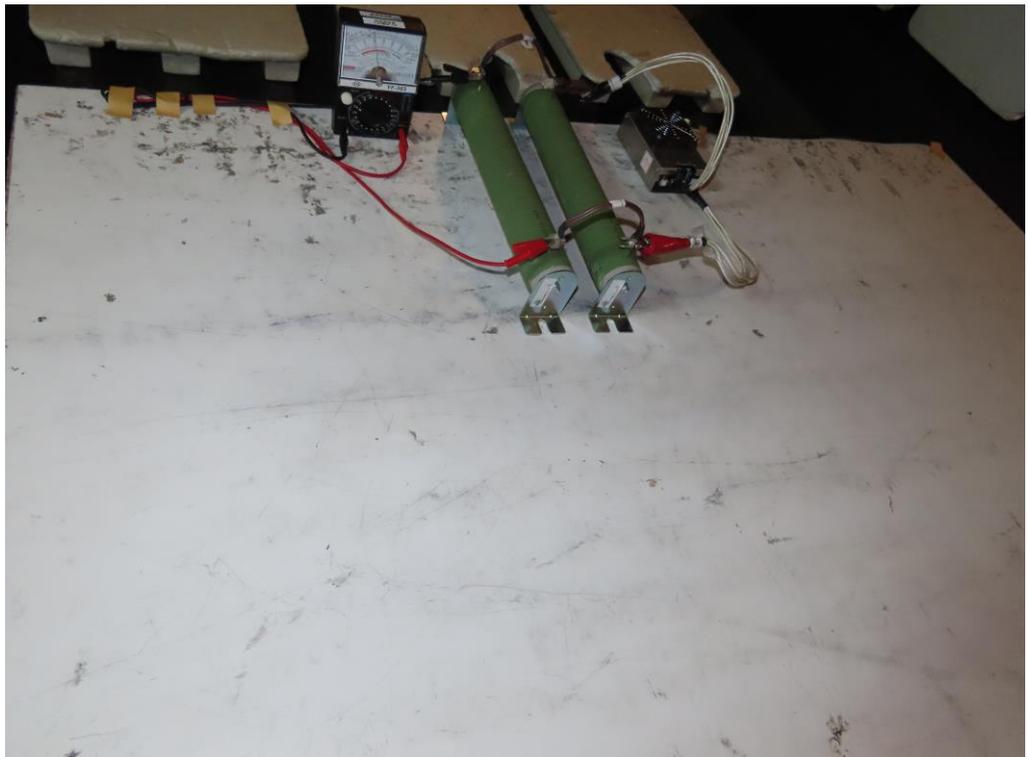


## 5. Photographs of RS Immunity Test Configuration

Front View



Rear View



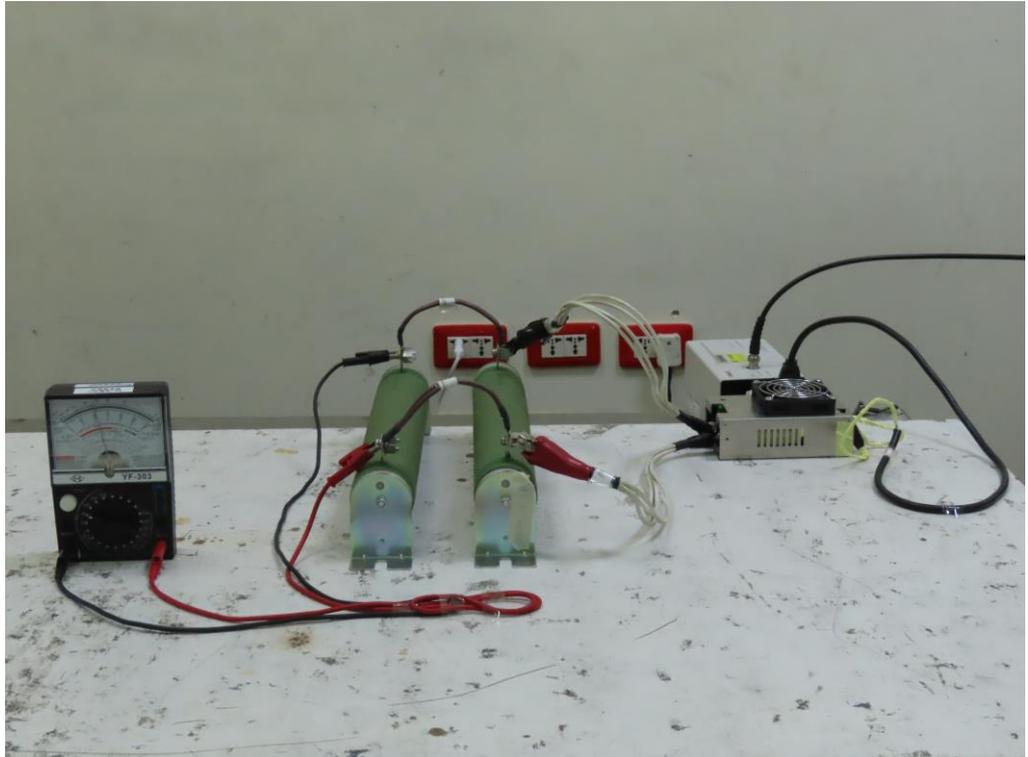
## 6. Photographs of EFT, Surge, Dip Test Configuration

Front View

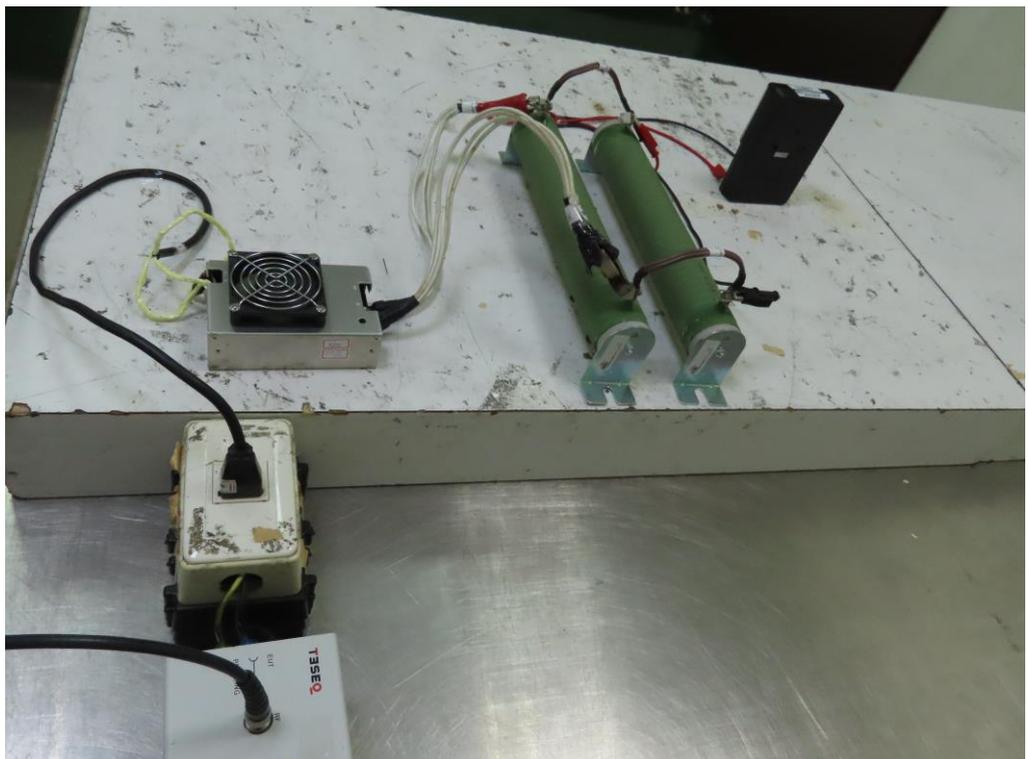


## 7. Photographs of CS Immunity Test Configuration

Front View



Rear View



## 8. Power Frequency Magnetic Field immunity Measurement (PFMF)

Front View



————THE END————