SPORTON LAB.

Project No : EC9D0321

VERIFICATION OF COMPLIANCE

Equipment : **AC-DC Power Module**
Model No. : **TMPW 25-105, TMPW 25-112 , TMPW 25-115, TMPW 25-124, TMPW 25-105-J, TMPW 25-112-J, TMPW 25-115-J, TMPW 25-124-J**
Applicant : **Traco Electronic AG**
Sihlbruggstrasse 111, 6340 Baar Switzerland

SPORTON LAB.

I HEREBY DECLARE THAT :

The equipment was **Passed** the test performed according to the following Standard **EN 55032:2015/AC:2016 Class B, EN 61000-3-2:2014, EN 61000-3-3:2013 and EN 55024:2010/A1:2015, EN 55035:2017 (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 2.1 2017-05).**
The test was carried out on **May 04, 2020** at **SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**.

Jack Deng

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

CE EMC TEST REPORT

Equipment	:	AC-DC Power Module
Brand Name	:	TRACO
Model Name	:	TMPW 25-105 , TMPW 25-112 , TMPW 25-115 , TMPW 25-124 , TMPW 25-105-J , TMPW 25-112-J , TMPW 25-115-J , TMPW 25-124-J
Applicant	:	Traco Electronic AG Sihlbruggstrasse 111, 6340 Baar Switzerland
Manufacturer	:	Traco Electronic AG Sihlbruggstrasse 111, 6340 Baar Switzerland
Standard	:	EN 55032:2015/AC:2016 Class B EN 61000-3-2:2014 EN 61000-3-3:2013 EN 55024:2010/A1:2015 EN 55035:2017

The product was received on Dec. 13, 2019, and testing was started from Dec. 16, 2019 and completed on May 04, 2020. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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

Approved by: Jack Deng

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

TEL : 886-3-327-3456
FAX : 886-3-327-0973
Report Template No.: HE3-L2M2V1 Ver1.1

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Appendix A. Test Photos

Photographs of EUT v01

History of this test report

Report No.	Version	Description	Issued Date
EC9D0321	01	Initial issue of report	May 19, 2020

Summary of Test Result

Report Clause	Ref Std. Clause	Test Standard	Test Items	Result (PASS/FAIL)	Remark
Emission Tests and Conformance Test Specifications					
4.1	A.3	EN 55032:2015/AC:2016 Class B	Conducted Emission	PASS	Under limit 8.64 dB at 0.55 MHz
-	A.3		Conducted Emissions of telecommunication Ports	Not Applicable	Note 1
4.2	A.2		Radiated Emissions below 1GHz	PASS	Under limit 3.59 dB at 128.010 MHz
-	A.2		Radiated Emissions above 1GHz	Not Applicable	Note 2
4.3	6.2	EN 61000-3-2:2014	Harmonic Current Emissions	Not Applicable	Note 3
4.4	6.1	EN 61000-3-3:2013	Voltage Fluctuations and Flicker	PASS	-

Note 1: This EUT without telecommunication ports, it's not necessary to apply to Telecom Port Conducted emission test.
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.
Note 3: The power consumption of EUT is lower than 75W, so the limit is not specified in IEC 61000-3-2:2014.

Report Clause	Ref Std. Clause	Test Standard	Test Items	Result (PASS/FAIL)	Remark
Immunity Tests and Conformance Test Specifications - EN 55024:2010/A1:2015					
5.2	4.2.1	IEC 61000-4-2 Edition 2.0 2008-12	ESD	PASS	-
5.3	4.2.3	IEC 61000-4-3 Edition 3.2 2010-04	RS	PASS	-
5.4	4.2.2	IEC 61000-4-4 Edition 3.0 2012-04	EFT/B - Power Port	PASS	-
	4.2.2	IEC 61000-4-4 Edition 3.0 2012-04	EFT/B - Telecom Port	Not Applicable	Note 1
5.5	4.2.5	IEC 61000-4-5 Edition 3.1 2017-08	Surges - Power Port	PASS	-
	4.2.5	IEC 61000-4-5 Edition 3.1 2017-08	Surges - Telecom Port	Not Applicable	Note 1
5.6	4.2.3	IEC 61000-4-6 Edition 4.0 2013-10	CS - Power Port	PASS	-
	4.2.3	IEC 61000-4-6 Edition 4.0 2013-10	CS - Telecom Port	Not Applicable	Note 1
5.7	4.2.4	IEC 61000-4-8 Edition 2.0 2009-09	Power Frequency Magnetic Fields	PASS	-
5.8	4.2.6	IEC 61000-4-11 Edition 2.1 2017-05	Voltage dips	PASS	-
	4.2.6	IEC 61000-4-11 Edition 2.1 2017-05	Voltage interruptions	PASS	-

Note 1: This EUT without telecommunication ports.

Report Clause	Ref Std. Clause	Test Standard	Test Items	Result (PASS/FAIL)	Remark
Immunity Tests and Conformance Test Specifications - EN 55035:2017					
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	-
	4.2.4	IEC 61000-4-4 Edition 3.0 2012-04	EFT/B - 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	-
	4.2.5	IEC 61000-4-5 Edition 3.1 2017-08	Surges - 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	-
	4.2.2.3	IEC 61000-4-6 Edition 4.0 2013-10	CS - 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 2.1 2017-05	Voltage dips	PASS	-
	4.2.6	IEC 61000-4-11 Edition 2.1 2017-05	Voltage interruptions	PASS	-
Note 1: This EUT without Analogue/digital data ports.					

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and explanations:
None

Reviewed by: Mark Ma

Report Producer: Amber Chiu

1. General Description of Equipment under Test

1.1. Basic Description of Equipment under Test

Equipment	:	AC-DC Power Module
Model No		TMPW 25 105 , TMPW 25 112 , TMPW 25 115 , TMPW 25 124 , TMPW 25 105 J , TMPW 25 112 J , TMPW 25 115 J , TMPW 25 124 J
Power Supply Type		Switching
AC Power Cord	:	Non-Shielded, 1.8 m, 2 pin
DC Power Cable	:	Non-Shielded, 0.05 m

The maximum operating frequency : 145 kHz

1.2. Table for Multiple Listing, Information from manufacturer

All the models are identical, the difference model for difference brand served as marketing strategy.

1.3. Feature of Equipment under Test

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

2. Test Configuration of Equipment under Test

2.1. Details of EUT Test Modes

From the above models, Model: TMPW 25-124, TMPW 25-124-J was selected as representative model for the test and its data was recorded in this report. The equipment under test were performed the following test modes:

Test Items	Description of test modes
Conducted Emission	Mode 1. TMPW 25-124, Full Load Mode 2. TMPW 25-124-J, Full Load
Radiated Emissions <below 1GHz>	Mode 1. TMPW 25-124, Full Load Mode 2. TMPW 25-124-J, Full Load

Test Items	Description of test modes
Harmonic and Flicker Emissions	Mode 1. TMPW 25-124, Full Load Mode 2. TMPW 25-124-J, Full Load
EMS	Mode 1. TMPW 25-124, Full Load Mode 2. TMPW 25-124-J, Full Load

2.2. Description of Test System

Conducted emission and radiated emission below 1GHz

No.	Peripheral	Manufacturer	Model Number	FCC ID	Remarks
For Local					
A	Load	N/A	N/A	N/A	Client Provided

EMS

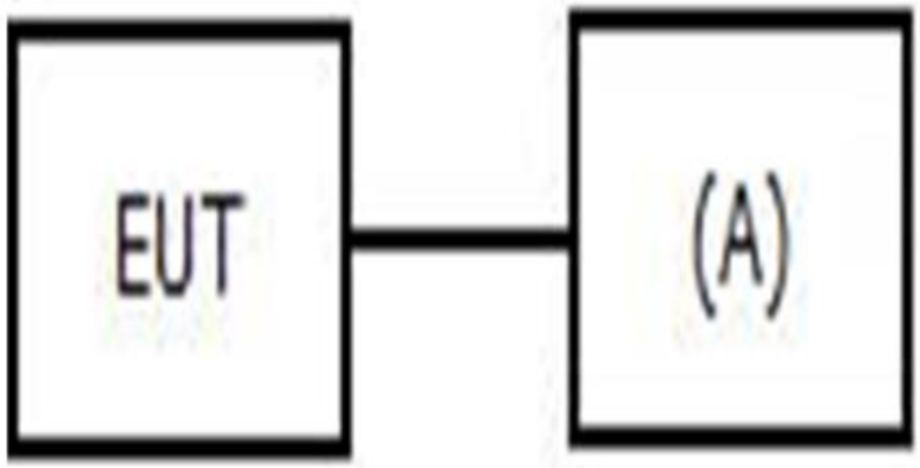
EN55024

No.	Peripheral	Manufacturer	Model Number	Types of Cables	Remarks
For Local					
A	Load	N/A	N/A	-	Client Provided
B	Multi-meter	YFE	YF-303	Probe Cable, non-Shielded, 1.5m	-

EN55035

No.	Peripheral	Manufacturer	Model Number	Types of Cables	Remarks
For Local					
A	Load	N/A	N/A	-	Client Provided
B	Multi-meter	YFE	YF-303	Probe Cable, non-Shielded, 0.7m	-
C	Multi-meter	YFE	YF-370A	Probe Cable, non-Shielded, 1.5m	For ESD

2.3. Connection Diagram of Test System

Test Setup Diagram


2.4. Test Manner

The device under test is connected to the dummy load and tested in full load mode.

3. General Information of Test

3.1. Test Facilities

Test Site : SPORTON INTERNATIONAL INC.			
☒	HUA YA	ADD :	No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)
		TEL :	886-3-327-3456 FAX : 886-3-318-0055
☒	DONG HU	ADD :	No. 3, Ln. 238, Kangle St., Neihu Dist., Taipei City, Taiwan (R.O.C.)
		TEL :	886-2-2631-5551 FAX : 886-2-2631-9740
☐	LIN KOU	ADD :	No. 30-2, Dingfu Vil., Linkou Dist., New Taipei City, Taiwan (R.O.C.)
		TEL :	886-2-2601-1640 FAX : 886-2-2601-1695

Test Items	Test Site No.	Test Engineer	Test Environment			Test Date	Remark
			temp °C	humidity %	pressure kPa		
Powerline Conducted Emissions	CO01-NH	Willy	21.1~21.3	55.2~55.5	-	16/Dec/2019	-
Radiated Emissions (below 1GHz)	OS02-NH	Chas	23.2~23.4	54.2~54.5	-	16/Dec/2019	-
Harmonic Current Emissions	EX01-HY	Harry	23.3-23.5	49.9-50.3	100	28/Apr/2020	EN55024
	EX01-HY	Alex	23.4~23.8	48.2~48.7	100.1	23/Dec/2019	EN55035
Voltage Fluctuations and Flicker	EX01-HY	Harry	23.3-23.5	49.9-50.3	100	28/Apr/2020	EN55024
	EX01-HY	Alex	23.4~23.8	48.2~48.7	100.1	23/Dec/2019	EN55035
ESD	ES02-HY	Harry	23.5-23.7	50.1-50.3	100	29/Apr/2020	EN55024
	ES02-HY	Cage	22.8-23.2	51.5~51.8	100	18/Dec/2019	EN55035
RS	RS06-HY	Harry	21.1-21.2	51.1-51.2	100	04/May/2020	EN55024
	RS06-HY	Jaily	22.2-22.6	48.2-48.5	100	24/Dec/2019	EN55035
EFT/B	EX02-HY	Harry	23.3-23.5	49.2-49.5	100	28/Apr/2020	EN55024
	EX01-HY	Alex	23.4~23.8	48.2~48.7	100.1	23/Dec/2019	EN55035
Surge	EX02-HY	Harry	23.3-23.5	49.2-49.5	100	28/Apr/2020	EN55024
	EX01-HY	Alex	23.4~23.8	48.2~48.7	100.1	23/Dec/2019	EN55035
CS	CS03-HY	Harry	24-24.2	51-51.2	100	29/Apr/2020	EN55024
	CS03-HY	Alex	22.4~22.8	48.5~48.9	100	23/Dec/2019	EN55035
Power Frequency Magnetic Fields	EX02-HY	Harry	23.3-23.5	49.2-49.5	100	28/Apr/2020	EN55024
	EX02-HY	Easton	23.5~23.6	50.1~50.3	100.1	23/Dec/2019	EN55035
Voltage dips and interruptions	EX02-HY	Harry	23.3-23.5	49.2-49.5	100	28/Apr/2020	EN55024
	EX01-HY	Alex	23.4~23.8	48.2~48.7	100.1	23/Dec/2019	EN55035

3.2. Test Standards

Test items	Test Standards and Test Procedures
Radiated and Conducted Emissions	European Standard EN 55032 Class B
Harmonics	European Standard EN 61000-3-2
Voltage Fluctuation	European Standard EN 61000 3 3
EMS	European Standard EN 55024 (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)
'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 Power Supply	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 require 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

conducted emissions from the AC mains power ports of Class A equipment			
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

conducted emissions from the AC mains power ports of Class B equipment			
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: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.			

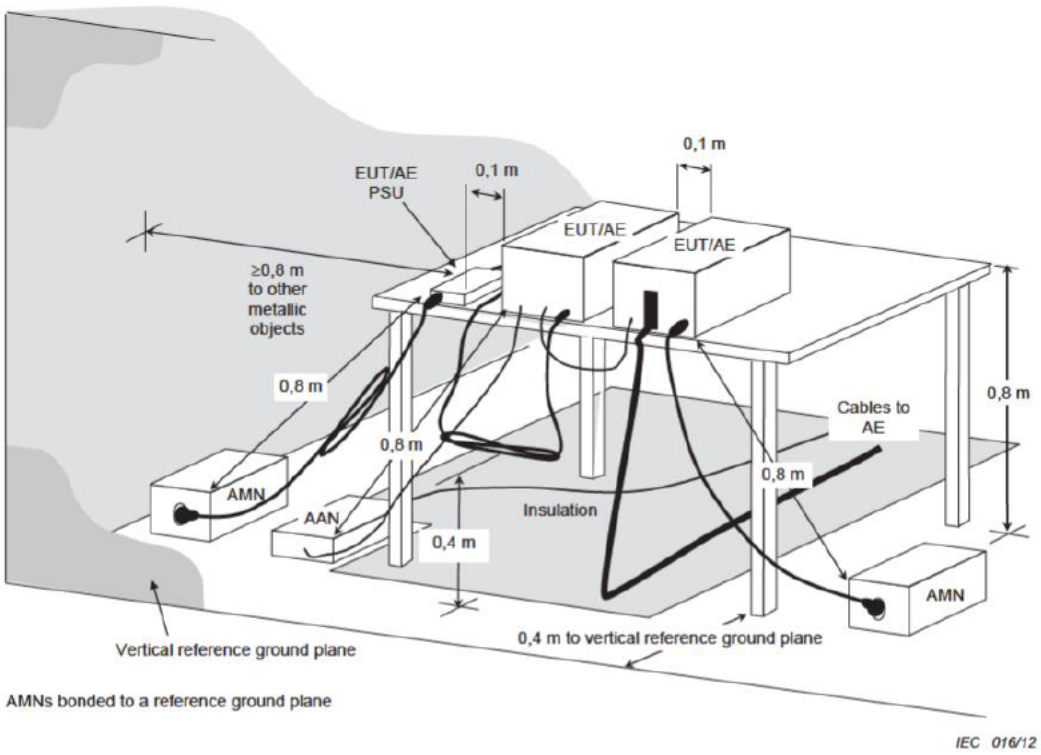
4.1.2. Test Procedures

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.

4.1.3. Measurement Results Calculation

The measurand Level is calculated using:
Corrected Reading (dBμV) = 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 dBμV, the signal strength would be calculated:
Corrected Reading (dBμV) = 10.48 dB + 0.10 dB + 36.39 dBμV = 46.97 dBμV

4.1.4. Typical Test Setup Layout

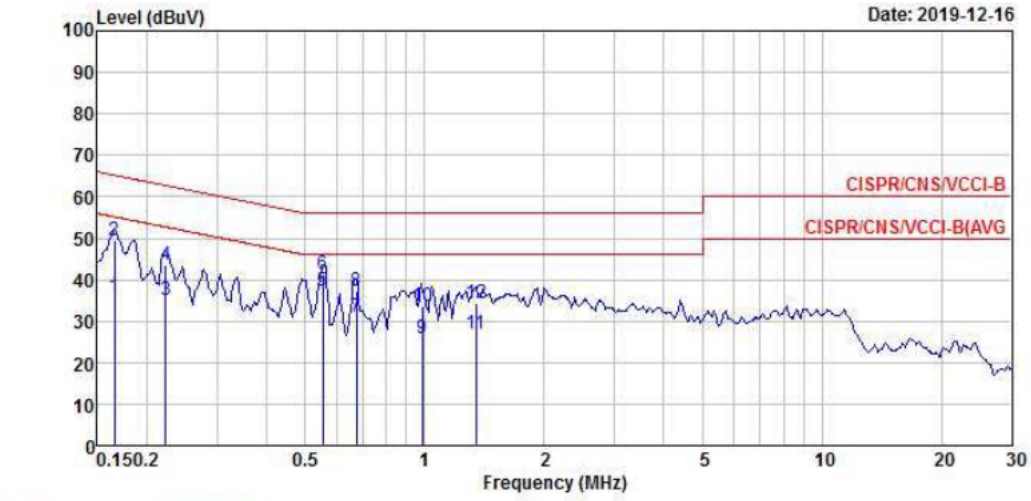


a). AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
b). EUT is connected to one artificial mains network (AMN)
c). All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
d). Rear of EUT to be flushed 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.

4.1.5. Test Result

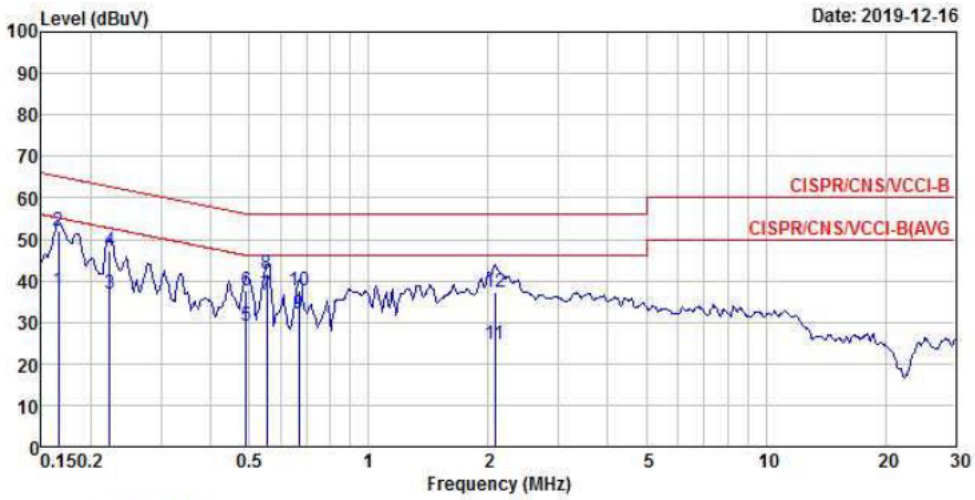
Test Mode	Mode 1		
Test Frequency	0.15 MHz ~ 30 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Line



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	35.95	-19.21	55.16	25.64	10.21	0.10	Average
2	0.17	49.47	-15.69	65.16	39.16	10.21	0.10	QP
3	0.22	34.92	-17.78	52.70	24.62	10.20	0.10	Average
4	0.22	43.67	-19.03	62.70	33.37	10.20	0.10	QP
5 @	0.55	37.36	-8.64	46.00	27.02	10.20	0.14	Average
6	0.55	41.29	-14.71	56.00	30.95	10.20	0.14	QP
7	0.67	31.11	-14.89	46.00	20.75	10.20	0.16	Average
8	0.67	37.17	-18.83	56.00	26.81	10.20	0.16	QP
9	0.98	25.69	-20.31	46.00	15.29	10.20	0.20	Average
10	0.98	33.46	-22.54	56.00	23.06	10.20	0.20	QP
11	1.34	26.89	-19.11	46.00	16.48	10.21	0.20	Average
12	1.34	34.40	-21.60	56.00	23.99	10.21	0.20	QP

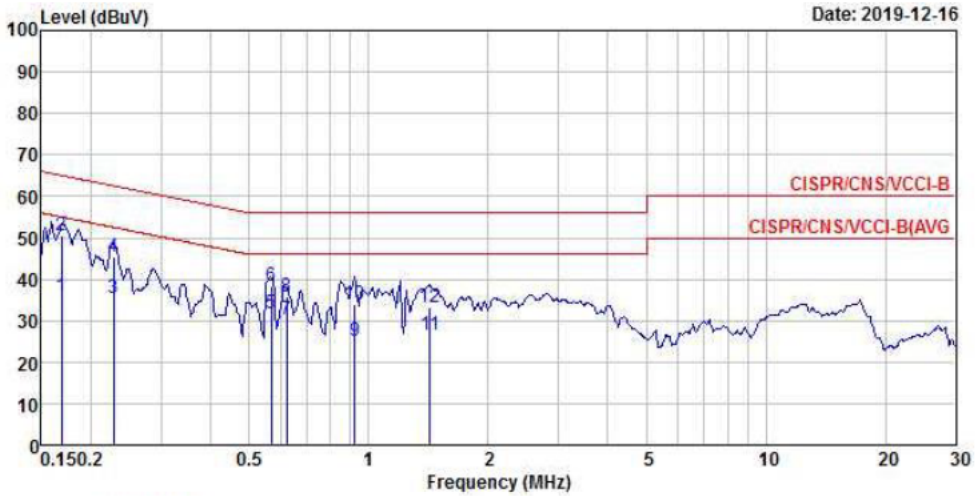
Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	37.54	-17.62	55.16	27.28	10.16	0.10	Average
2	0.17	51.91	-13.25	65.16	41.65	10.16	0.10	QP
3	0.22	36.90	-15.80	52.70	26.64	10.16	0.10	Average
4	0.22	47.20	-15.50	62.70	36.94	10.16	0.10	QP
5	0.49	29.16	-16.98	46.14	18.89	10.15	0.12	Average
6	0.49	37.61	-18.53	56.14	27.34	10.15	0.12	QP
7 @	0.55	36.65	-9.35	46.00	26.36	10.15	0.14	Average
8	0.55	41.53	-14.47	56.00	31.24	10.15	0.14	QP
9	0.67	32.19	-13.81	46.00	21.87	10.16	0.16	Average
10	0.67	37.69	-18.31	56.00	27.37	10.16	0.16	QP
11	2.08	24.62	-21.38	46.00	14.23	10.18	0.21	Average
12	2.08	37.25	-18.75	56.00	26.86	10.18	0.21	QP

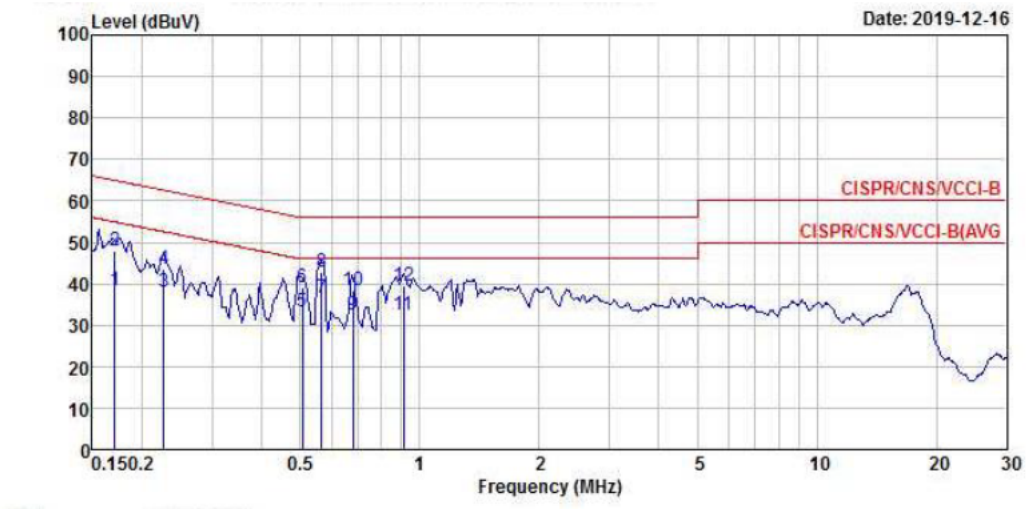
Test Mode	Mode 2		
Test Frequency	0.15 MHz ~ 30 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Line



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	35.81	-19.22	55.03	25.50	10.21	0.10	Average
2	0.17	50.73	-14.30	65.03	40.42	10.21	0.10	QP
3	0.23	35.60	-16.92	52.52	25.30	10.20	0.10	Average
4	0.23	45.46	-17.06	62.52	35.16	10.20	0.10	QP
5 @	0.57	31.73	-14.27	46.00	21.39	10.20	0.14	Average
6	0.57	38.48	-17.52	56.00	28.14	10.20	0.14	QP
7	0.62	30.40	-15.60	46.00	20.05	10.20	0.15	Average
8	0.62	35.65	-20.35	56.00	25.30	10.20	0.15	QP
9	0.92	25.19	-20.81	46.00	14.80	10.20	0.19	Average
10	0.92	33.87	-22.13	56.00	23.48	10.20	0.19	QP
11	1.43	26.39	-19.61	46.00	15.98	10.21	0.20	Average
12	1.43	33.19	-22.81	56.00	22.78	10.21	0.20	QP

Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.17	38.54	-16.38	54.92	28.28	10.16	0.10	Average
2	0.17	48.14	-16.78	64.92	37.88	10.16	0.10	QP
3	0.23	38.09	-14.48	52.57	27.83	10.16	0.10	Average
4	0.23	43.48	-19.09	62.57	33.22	10.16	0.10	QP
5	0.51	33.15	-12.85	46.00	22.87	10.15	0.13	Average
6	0.51	39.23	-16.77	56.00	28.95	10.15	0.13	QP
7 @	0.57	36.71	-9.29	46.00	26.42	10.15	0.14	Average
8	0.57	42.68	-13.32	56.00	32.39	10.15	0.14	QP
9	0.68	32.54	-13.46	46.00	22.22	10.16	0.16	Average
10	0.68	38.53	-17.47	56.00	28.21	10.16	0.16	QP
11	0.91	32.51	-13.49	46.00	22.16	10.16	0.19	Average
12	0.91	39.53	-16.47	56.00	29.18	10.16	0.19	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

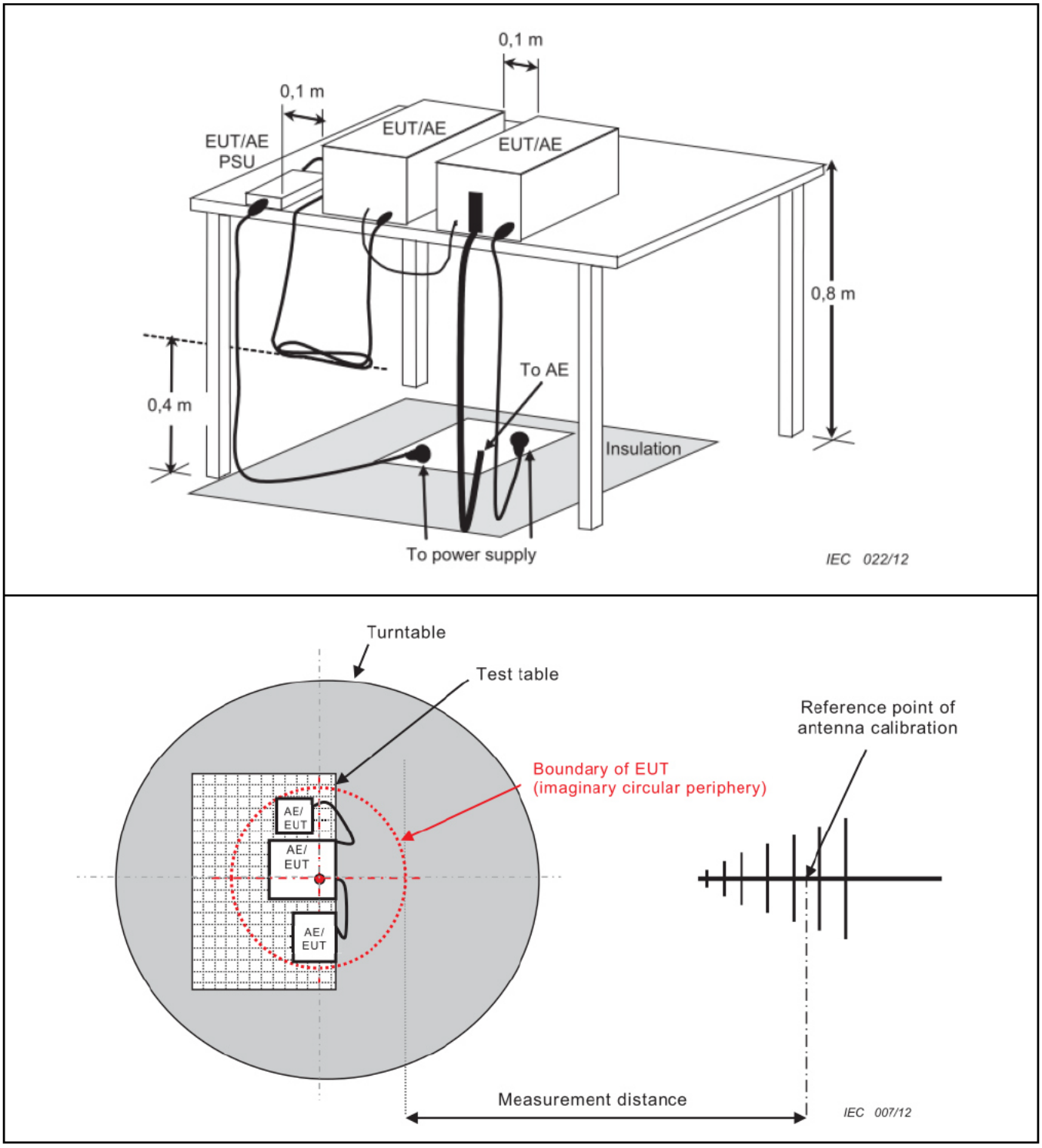
4.2.2. Test Procedures

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 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.

4.2.3. Measurement Results Calculation

The measurand Level is calculated using:
Corrected Reading (dBμV/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 dBμV and the Preamp Factor is 27.18 dB, the signal strength would be calculated:
Corrected Reading (dBμV/m) = 17.24 dB/m + 1.20 dB + 35.80 dBμV - 27.18 dB = 27.06 dBμV/m
Note: If a hybrid antenna is used, the antenna factor shell be the sum of the Antenna Factor + Attenuator Factor.

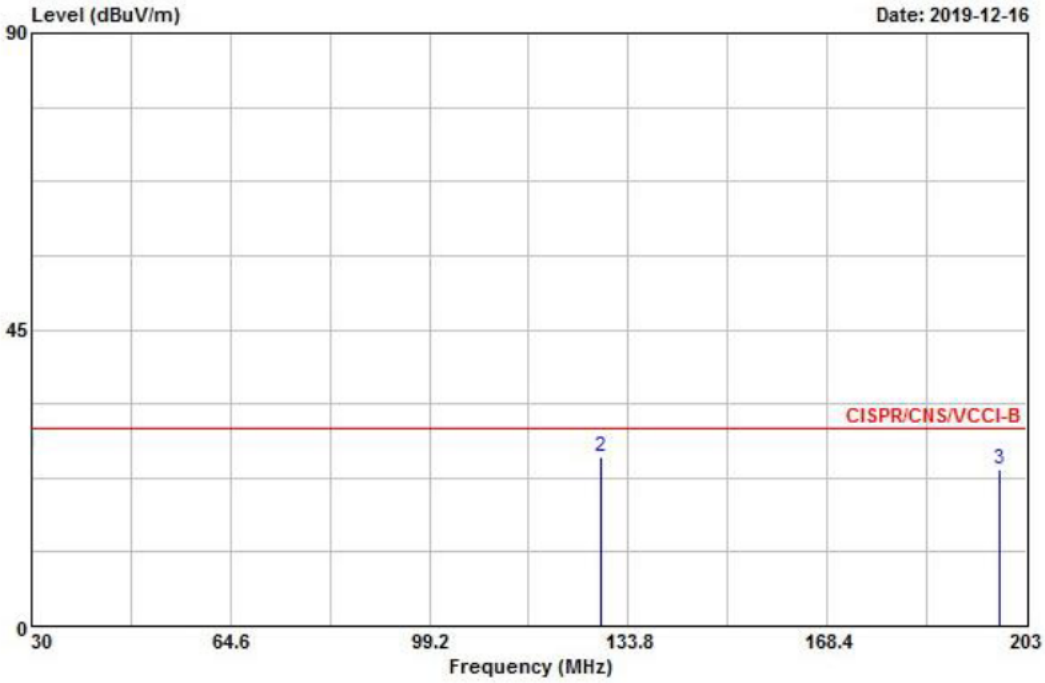
4.2.4. Typical Test Setup Layout



4.2.5. Test Result

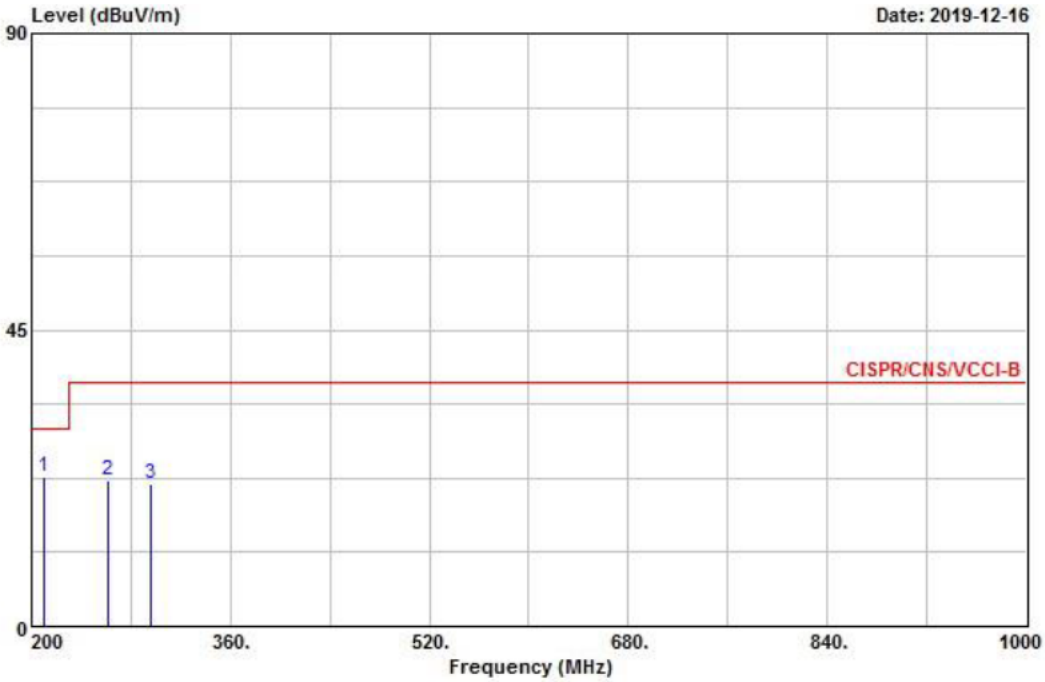
Test mode	Mode 1		
Test frequency	30 MHz ~ 1000 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



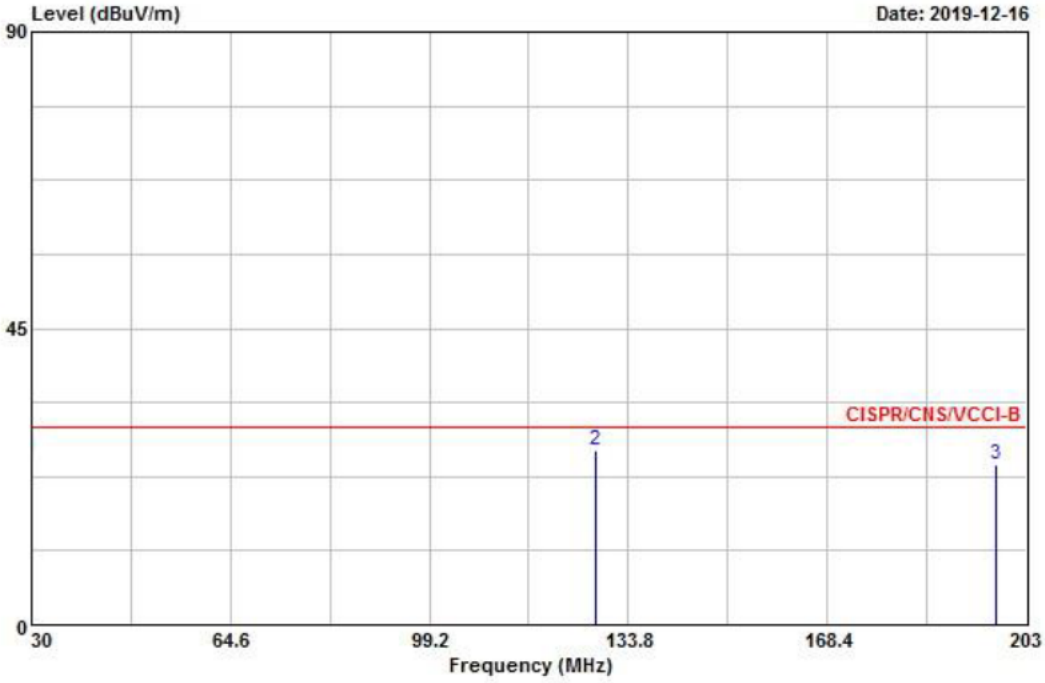
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	30.000	26.12	-3.88	30.00	28.70	23.79	1.00	27.37	Peak	---	---
2	129.090	25.68	-4.32	30.00	34.15	16.91	1.75	27.13	Peak	---	---
3	198.210	23.91	-6.09	30.00	34.11	14.50	2.18	26.88	Peak	---	---

Vertical



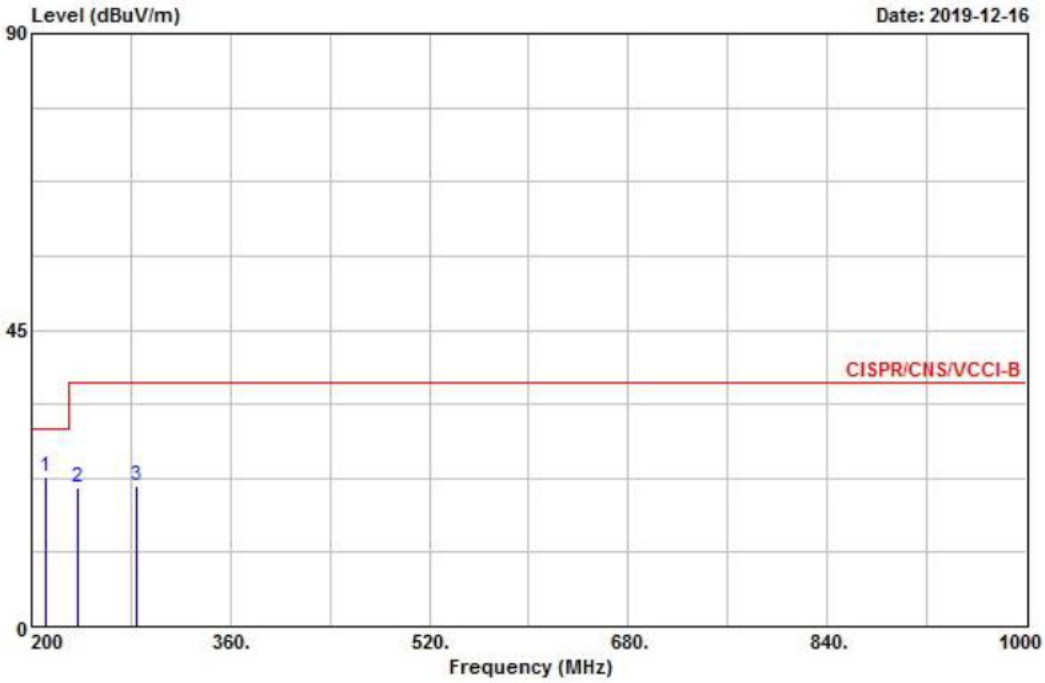
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	210.090	22.62	-7.38	30.00	32.07	15.17	2.24	26.86	Peak	---	---
2	261.390	22.10	-14.90	37.00	28.60	17.77	2.47	26.74	Peak	---	---
3	295.950	21.56	-15.44	37.00	27.21	18.37	2.68	26.70	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read 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	25.29	-4.71	30.00	27.87	23.79	1.00	27.37	Peak	---	---
2 @	128.010	26.41	-3.59	30.00	34.84	16.97	1.74	27.14	Peak	400	129
3	197.670	24.37	-5.63	30.00	34.57	14.50	2.18	26.88	Peak	---	---

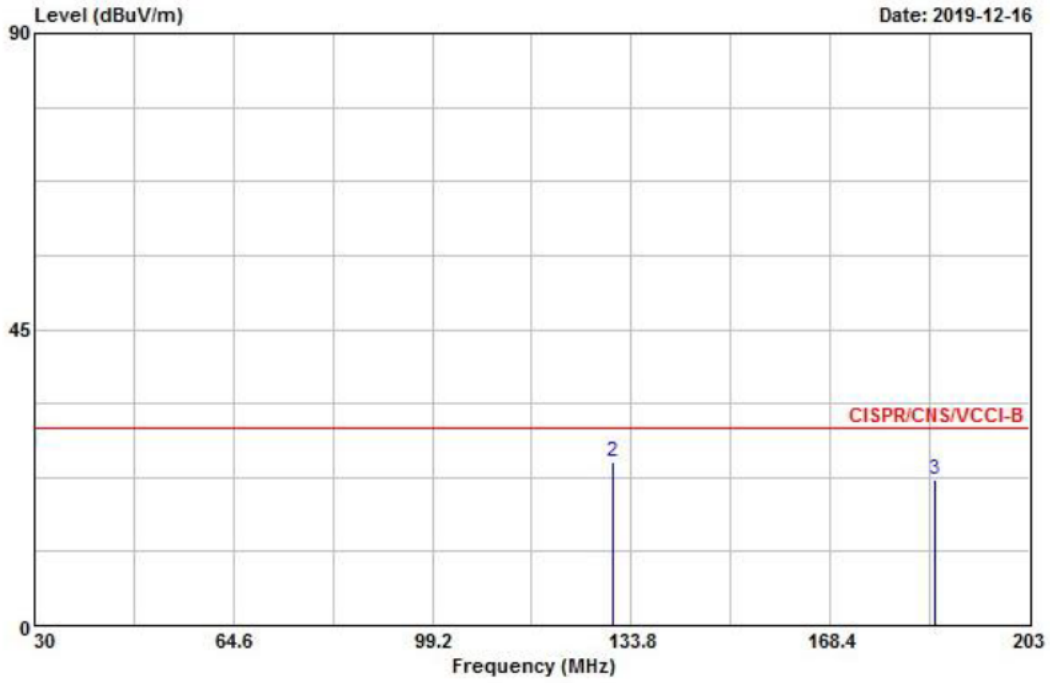
Horizontal



	Freq	Level	Over Limit	Limit Line	Read 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	211.440	22.61	-7.39	30.00	32.00	15.22	2.25	26.86	Peak	---	---
2	237.090	21.13	-15.87	37.00	28.82	16.75	2.35	26.79	Peak	---	---
3	284.340	21.23	-15.77	37.00	27.17	18.17	2.61	26.72	Peak	---	---

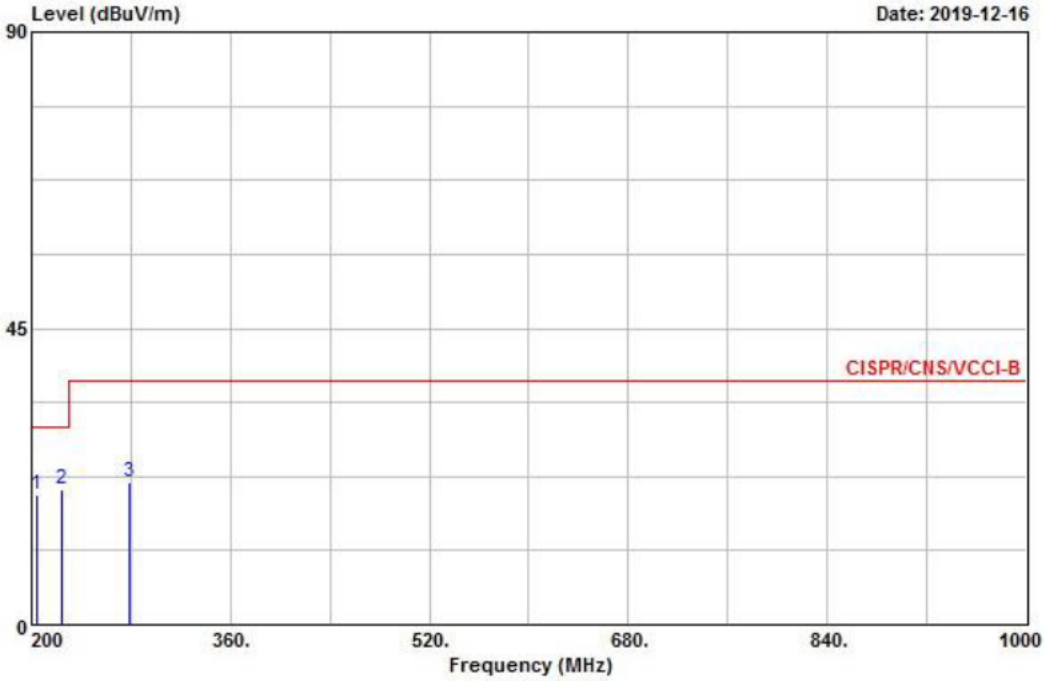
Test mode	Mode 2		
Test frequency	30 MHz ~ 1000 MHz	Test Voltage	AC 230V / 50Hz
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



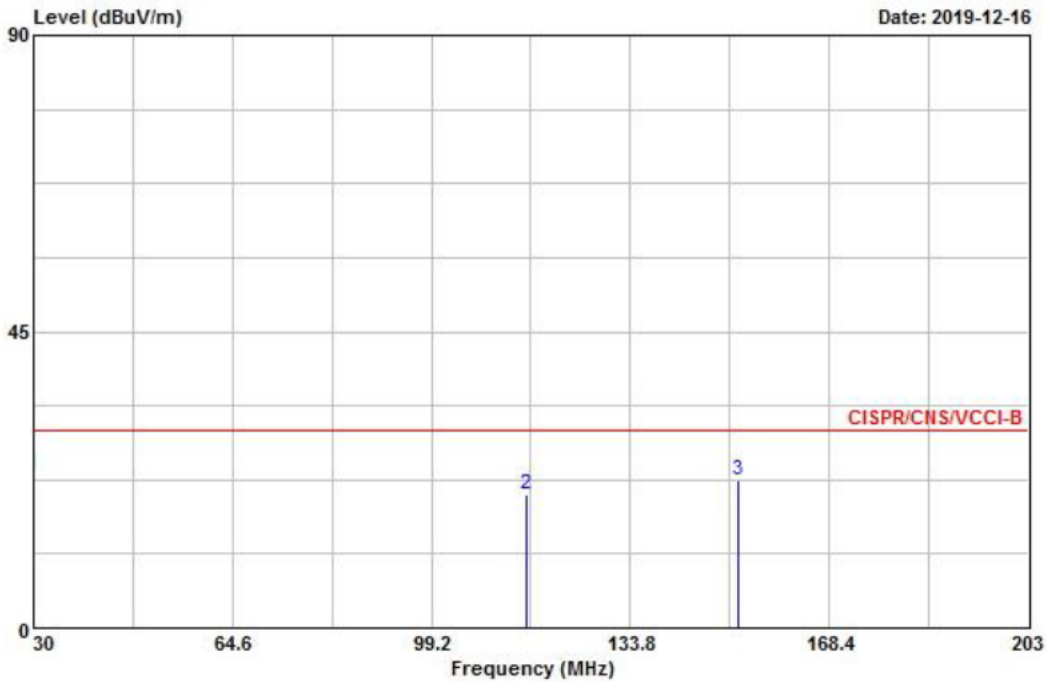
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1 @	30.000	26.09	-3.91	30.00	28.67	23.79	1.00	27.37	Peak	100	202
2	130.440	24.77	-5.23	30.00	33.31	16.80	1.75	27.09	Peak	---	---
3	186.600	22.18	-7.82	30.00	32.58	14.35	2.06	26.81	Peak	---	---

Vertical



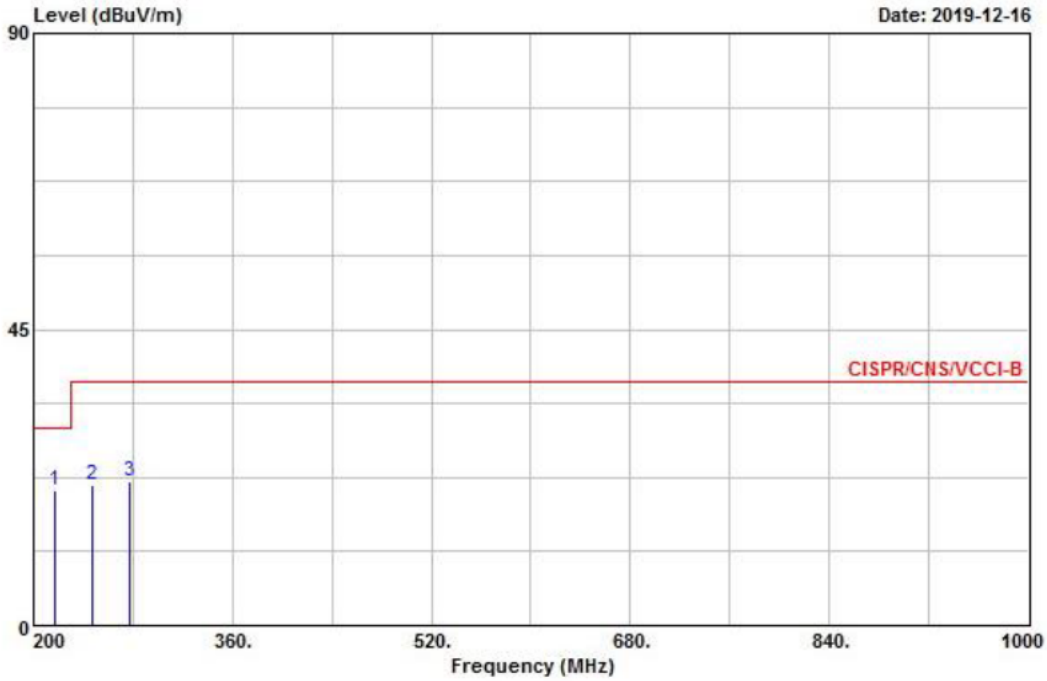
	Freq	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	204.420	19.76	-10.24	30.00	29.61	14.81	2.22	26.88	Peak	---	---
2	224.400	20.57	-9.43	30.00	29.10	15.99	2.30	26.82	Peak	---	---
3	278.670	21.60	-15.40	37.00	27.69	18.06	2.57	26.72	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read 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	23.38	-6.62	30.00	25.96	23.79	1.00	27.37	Peak	---	---
2	115.860	20.32	-9.68	30.00	29.04	16.90	1.68	27.30	Peak	---	---
3	152.580	22.51	-7.49	30.00	31.87	15.58	1.86	26.80	Peak	---	---

Horizontal



	Freq	Level	Over Limit	Limit Line	Read 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	217.110	20.41	-9.59	30.00	29.40	15.58	2.27	26.84	Peak	---	---
2	247.350	21.32	-15.68	37.00	28.30	17.39	2.39	26.76	Peak	---	---
3	277.320	21.79	-15.21	37.00	27.90	18.05	2.56	26.72	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 ≤16 A par 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]
Odd harmonics				
3	2.30	3.45	30 x λ	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 ≤ n ≤ 39	0.15 x 15/n	0.225 x 15/n	3	3.85/n
Even harmonics				
2	1.08	1.62	2	-
4	0.43	0.645	-	-
6	0.30	0.45	-	-
8 ≤ n ≤ 40	0.23 x 8/n	0.345 x 8/n	-	-

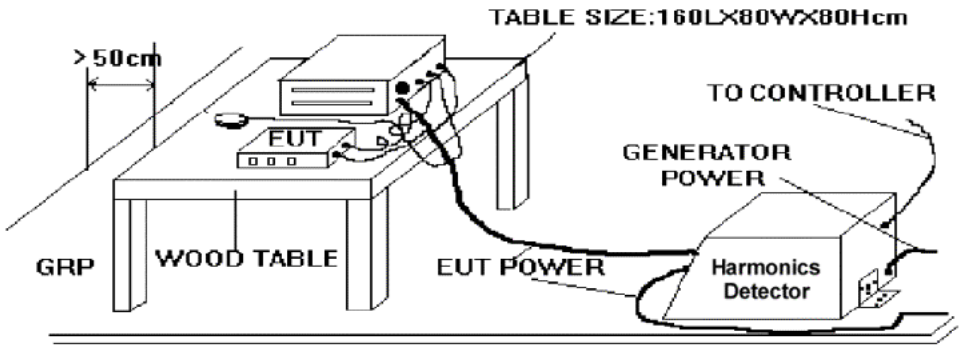
4.3.2. Test Procedure

The test procedures followed are those specified in EN 61000-3-2:2014.

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

EN55024

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

V_RMS (Volts):	230.76	Frequency(Hz):	50.00
I_Peak (Amps):	1.020	I_RMS (Amps):	0.247
I_Fund (Amps):	0.127	Crest Factor:	4.133
Power (Watts):	26.9	Power Factor:	0.478

Test mode	Mode 2		
Test Voltage	AC 230V / 50Hz	Device Class	A

V_RMS (Volts):	230.75	Frequency(Hz):	50.00
I_Peak (Amps):	1.068	I_RMS (Amps):	0.253
I_Fund (Amps):	0.125	Crest Factor:	4.229
Power (Watts):	26.7	Power Factor:	0.464

EN55035

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

V_RMS (Volts):	230.80	Frequency(Hz):	50.00
I_Peak (Amps):	1.101	I_RMS (Amps):	0.252
I_Fund (Amps):	0.127	Crest Factor:	4.377
Power (Watts):	26.9	Power Factor:	0.464

Test mode	Mode 2		
Test Voltage	AC 230V / 50Hz	Device Class	A

V_RMS (Volts):	230.81	Frequency(Hz):	50.00
I_Peak (Amps):	1.087	I_RMS (Amps):	0.254
I_Fund (Amps):	0.125	Crest Factor:	4.288
Power (Watts):	26.6	Power Factor:	0.457

The power consumption of EUT is lower than 75W, so the limit is not specified in IEC 61000-3-2:2014.

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 ≤ 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_{lt} 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 %.

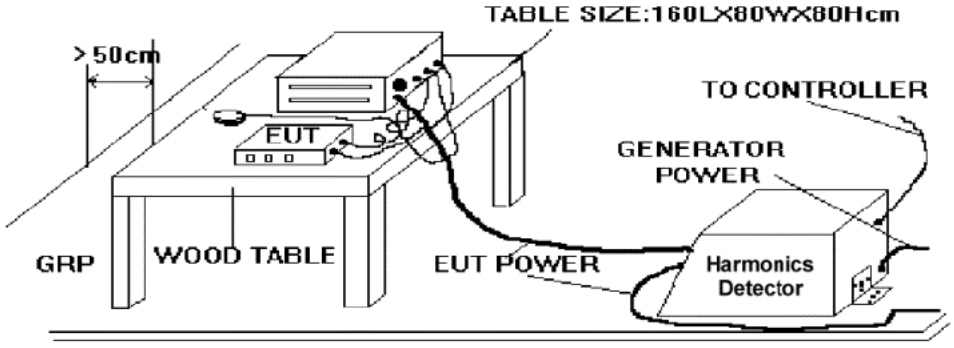
4.4.2. Test Procedure

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

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

EN55024

Test mode	Mode 1	Test Voltage	AC 230V / 50Hz

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.69			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.02	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.271	Test limit:	1.000	Pass

Test mode	Mode 2	Test Voltage	AC 230V / 50Hz

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.65			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.02	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.261	Test limit:	1.000	Pass

EN55035

Test mode	Mode 1	Test Voltage	AC 230V / 50Hz

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.63			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.06	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.269	Test limit:	1.000	Pass

Test mode	Mode 2	Test Voltage	AC 230V / 50Hz

Parameter values recorded during the test:

Vrms at the end of test (Volt):	230.76			
Highest dt (%):	0.00	Test limit (%):	3.30	Pass
T-max (mS):	0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.06	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.253	Test limit:	1.000	Pass

5. Immunity Measurement

5.1. General performance criteria

Applicable Standard: EN 55024	
Criteria A	During and after the test the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed below a minimum performance level specified by the manufacturer when the EUT 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 EUT if used as intended.
Criteria B	After the test, the EUT shall continue to operate as intended without operator intervention. No degradation of performance or loss of function is allowed, after the application of the phenomena below a performance level specified by the manufacturer, when the EUT is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is allowed. However, no change of operating state or stored data is allowed to persist after the test. 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 EUT if used as intended.
Criteria C	During and after testing, a temporary loss of function is allowed, provided the function is self-recoverable, or can be restored by the operation of the controls or cycling of the power to the EUT by the user in accordance with the manufacturer's instructions. Functions, and/or information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

Applicable Standard: EN 55035	
Criteria A	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..
Criteria 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.
Criteria C	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

Reference Standard	IEC 61000-4-2
Discharge Impedance	330 Ω / 150 pF
Polarity	Positive and negative
Single Discharge Mode	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.

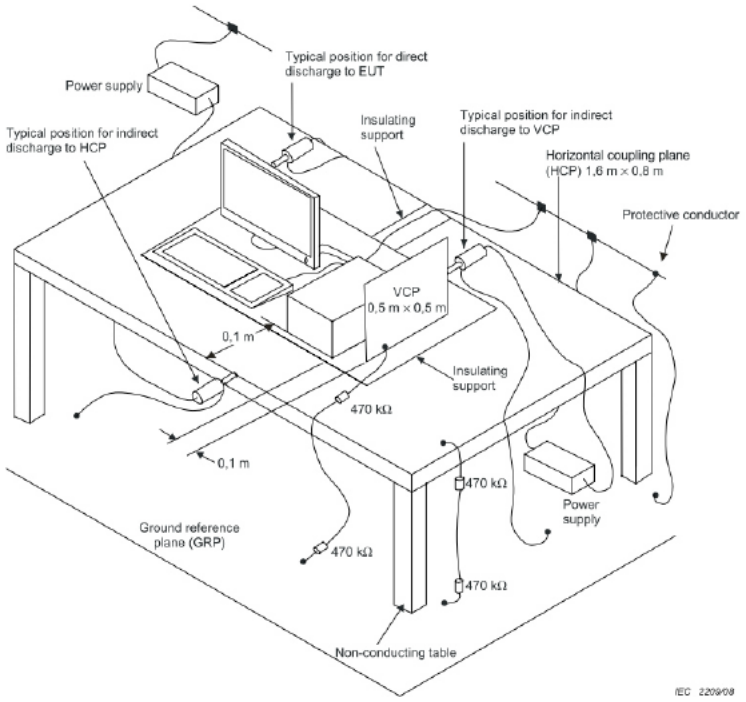
d. For the time interval between successive single discharges an initial value of one second is recommended. Longer intervals may be necessary to determine whether a system failure has occurred.

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 SPORTON EMC 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.

Where the EUT is installed on a metal table, the table was connected to the reference plane via a cable with a 470k ohm resister 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.

5.2.1. Test Result

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	**Final Test Result**	***PASS***
Contact discharge	2, 4 kV		
Air discharge	2, 4, 8 kV		
Performance Criteria	B		
Remark	Those points and surfaces of equipment which are no longer accessible after fixed installation or after following the instructions for use.		

Test Result - Air Discharge/Round Tip
No Air Discharge/Round Tip

Test Result - Contact Discharge/Pointed Tip
No Contact Discharge/Pointed Tip

Indirect discharge to HCP and VCP

Test Point	No. of Disch.	Test Result (Criteria)				Remark
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	25	A	A	A	A	-
HCP (At Left)	25	A	A	A	A	-
HCP (At Right)	25	A	A	A	A	-
HCP (At Rear)	25	A	A	A	A	-
VCP (At Front)	25	A	A	A	A	-
VCP (At Left)	25	A	A	A	A	-
VCP (At Right)	25	A	A	A	A	-
VCP (At Rear)	25	A	A	A	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	Final Test Result	PASS
Contact discharge	2, 4 kV		
Air discharge	2, 4, 8 kV		
Performance Criteria	B		
Remark	Those points and surfaces of equipment which are no longer accessible after fixed installation or after following the instructions for use.		

Test Result - Air Discharge/Round Tip
No Air Discharge/Round Tip

Test Result - Contact Discharge/Pointed Tip
No Contact Discharge/Pointed Tip

Indirect discharge to HCP and VCP

Test Point	No. of Disch.	Test Result (Criteria)				Remark
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	10	A	A	A	A	-
HCP (At Left)	10	A	A	A	A	-
HCP (At Right)	10	A	A	A	A	-
HCP (At Rear)	10	A	A	A	A	-
VCP (At Front)	10	A	A	A	A	-
VCP (At Left)	10	A	A	A	A	-
VCP (At Right)	10	A	A	A	A	-
VCP (At Rear)	10	A	A	A	A	-

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.	

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.

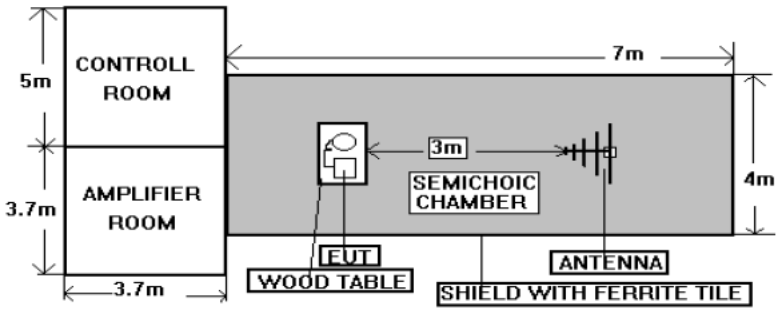
b). The bilog antenna which is enabling the complete frequency range of 80 to 1000 MHz, The horn antenna which is enabling the complete frequency range 1000 to 5000 MHz is placed 3m away from the equipment. The required field strength is determined by placing the field strength meter(s) on top of or 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 $1.5*10^{-3}$ 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

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	Final Test Result	PASS
Frequency Range	80 to 1000 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
80~1000	3	V&H	0, 90, 180, 270	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	Final Test Result	PASS
Frequency Range(swept)	80 to 1000 MHz		
Frequency Range(spot)	1800,2600,3500,5000 MHz (±1%)		
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
80~1000	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

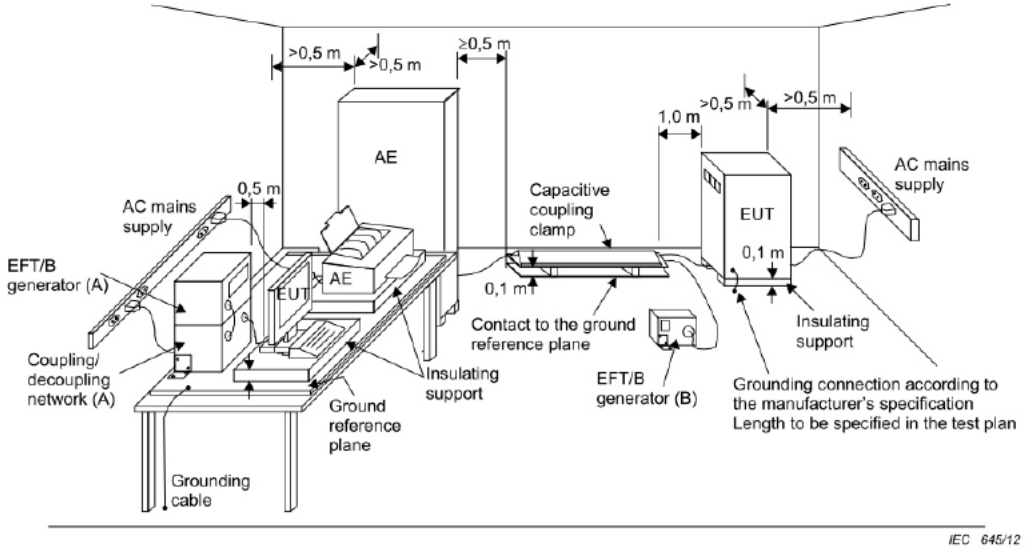
a). In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.

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 SPORTON EMC 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

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	**Final Test Result**	***PASS***
Test Voltage	**input a.c. power ports:** 0.5, 1.0 kV		
Impulse wave shape	5/50 ns (Tr/Th)		
Repetition frequency	5 kHz		
Performance Criteria	B		

Test Result - Input a.c. power ports:

Test Location	Test Voltage kV	Test Result (Criteria)		Remark
		pos. (+)	neg. (-)	
L+N	0.5	A	A	-
L+N	1.0	A	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	**Final Test Result**	***PASS***
Test Voltage	**Input a.c. power ports:** 0.5, 1.0 kV		
Impulse wave shape	5/50 ns (Tr/Th)		
Repetition frequency	5 kHz		
Performance Criteria	B		

Test Result - Input a.c. power ports:

Test Location	Test Voltage kV	Test Result (Criteria)		Remark
		pos. (+)	neg. (-)	
L+N	0.5	A	A	-
L+N	1.0	A	A	-

5.5. Surges

5.5.1. Test Specification

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

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	**Final Test Result**	***PASS***
Test Voltage	**Input a.c. power ports:** line to line: 0.5, 1.0 kV; line to earth or ground: 1.0, 2.0 kV		
Impulse wave shape	Input a.c. power ports: 1,2/50 (8/20) Tr/Th μs		
Performance Criteria	Input a.c. power ports: B		

Test Result - Input a.c. power ports:

Test Location	Test Voltage kV	Polarity pos. / neg.	Test Result (Criteria) Phase Angle (Degree)				Remark
			0°	90°	180°	270°	
L - N	0.5	+ / -	A	A	A	A	-
L - N	1.0	+ / -	A	A	A	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	**Final Test Result**	***PASS***
Test Voltage	**Input a.c. power ports:** line to line: 0.5, 1.0 kV		
Impulse wave shape	Input a.c. power ports: 1,2/50 (8/20) Tr/Th μs		
Performance Criteria	Input a.c. power ports: B		

Test Result - Input a.c. power ports:

Test Location	Test Voltage kV	Polarity pos. / neg.	Test Result (Criteria) Phase Angle (Degree)		Remark
			90°	270°	
L - N	0.5	+ / -	A	A	-
L - N	1.0	+ / -	A	A	-

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(μV)	U_0 V
1	120	1
2	129.5	3
3	140	10
x	Specified	
Remark : " x " is an open level.		

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 1.5×10^{-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

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	**Final Test Result**	***PASS***
Frequency Range	0.15 MHz to 80 MHz		
Test Voltage	3 V (unmodulated, r.m.s)		
Amplitude modulated	80% AM (1 kHz)		
Performance Criteria	A		

Frequency Range MHz	Test Voltage V rms	CDN	Test Port	Test Result (Criteria)	Remark
0.15 ~ 80	3	CDN-M016 SW M2	Input power port	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	**Final Test Result**	***PASS***
Frequency Range	0.15 to 10 MHz 10 to 30 MHz 30 to 80 MHz		
Test Voltage	3 V	unmodulated, r.m.s	
	3 to 1 V		
	1 V		
Amplitude modulated	80% AM (1 kHz)		
Performance Criteria	A		

Frequency Range MHz	Test Voltage V rms	CDN	Test Port	Test Result (Criteria)	Remark
0.15 ~ 10	3	CDN-M016 SW M2	Input power port	A	-
10 ~ 30	3 ~ 1	CDN-M016 SW M2	Input power port	A	-
30 ~ 80	1	CDN-M016 SW M2	Input power port	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

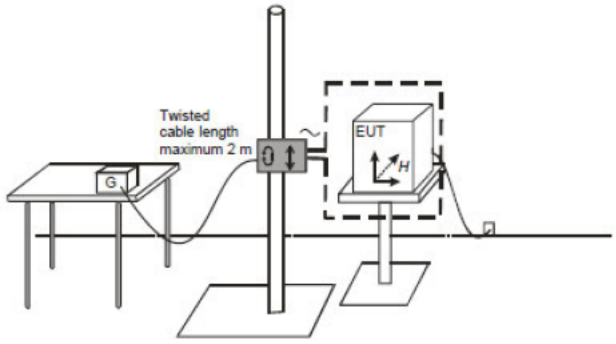
5.7.2. Test Levels

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-betweenthe other levels. This level can be given in the productspecification.	

5.7.3. Test Procedure

a). The equipment is configured and connected to satisfy its functional requirements.
b). The power supply, input and output circuits shall be connected to the sources of power supply, control and signal.
c). 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



EUT : Equipment under test G : Test Generator

5.7.5. Test Result

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	Final Test Result	*PASS*
Power-frequency	50 Hz	Magnetic field	1 A/m (r.m.s.)
Performance Criteria	A		

Power Frequency Magnetic Field	Testing duration	Coil Orientation	Test Result (Criteria)	Remark
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	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	Final Test Result	*PASS*
Power-frequency	50 Hz	Magnetic field	1 A/m (r.m.s.)
Performance Criteria	A		

Power Frequency Magnetic Field	Testing duration	Coil Orientation	Test Result (Criteria)	Remark
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

Reference Standard	IEC 61000-4-11
Phase shifting	0° / 180°
Test of interval	10 sec
Level and duration	Sequency of 3 dips/interrupts
Voltage rise (and fall) time	1 ~ 5 μs

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

Test mode	Mode 1 & 2		
Applicable Standard	EN 55024:2010/A1:2015	Final Test Result	PASS
Voltage dips	>95% reduction; 0,5 period 0% residual; 0,5 period (For applicant Requirement)		
	30% reduction; 25 periods 40% residual; 10 periods (For applicant Requirement)		
Voltage interruptions	>95% reduction; 250 periods		
Performance Criteria	B/C/C C/C/C(For applicant Requirement)		

Test Result of 100V/50Hz

Test Voltage (V)	Reduction Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
100	>95 %	0.5	A	A	-
100	30 %	25	A	A	-
100	>95 %	250	**B**	**B**	**Note[1]**
Note[1]	After the interruption. The power of EUT self-recoverable.				

Test Result of 240V/50Hz

Test Voltage (V)	Reduction Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
240	>95 %	0.5	A	A	-
240	30 %	25	A	A	-
240	>95 %	250	**B**	**B**	**Note[1]**
Note[1]	After the interruption. The power of EUT self-recoverable.				

Test Result of 100V/50Hz

Test Voltage (V)	Residual Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
100	0 %	0.5	A	A	-
100	40 %	10	A	A	-
100	70 %	25	A	A	-

Test Result of 240V/50Hz

Test Voltage (V)	Residual Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
240	0 %	0.5	A	A	-
240	40 %	10	A	A	-
240	70%	25	A	A	-

Test mode	Mode 1 & 2		
Applicable Standard	EN 55035:2017	Final Test Result	PASS
Voltage dips	<5% residual; 0,5 period 0% residual; 0,5 period (For applicant Requirement)		
	70% residual; 25 periods for 50Hz; 30 periods for 60Hz 40% residual; 10 periods (For applicant Requirement)		
Voltage interruptions	<5% residual; 250 periods for 50Hz; 300 periods for 60Hz		
Performance Criteria	B/C/C C/C/C(For applicant Requirement)		

Test Result of 100V/50Hz

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

Test Result of 240V/50Hz

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

Test Result of 100V/50Hz

Test Voltage (V)	Residual Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
100	0 %	0.5	B	B	Note[1]
100	40 %	10	B	B	Note[1]
100	70 %	25	B	B	Note[1]
Note[1]	After the interruption. The power of EUT self-recoverable.				

Test Result of 240V/50Hz

Test Voltage (V)	Residual Voltage	Duration (Periods)	Test Result (Criteria) (Phase Angle)		Remark
			0°	180°	
240	0 %	0.5	A	A	-
240	40 %	10	A	A	-
240	70%	25	A	A	-

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. Emission Test Measurement Uncertainty

Test Items	Test Site No.	U_{LAB}
Conducted Emissions	CO01-NH	2.7dB
Radiated Emissions below 1GHz	OS02-NH	5.8dB

6.2. Immunity Test Measurement Uncertainty

- **ESD Immunity (IEC 61000-4-2)**

Waveform Parameters
Voltage Tolerance: Setting +/- 5%
Current Peak Tolerance: I peak +/- 15 %
(10%/90%) Rise Time T1 Tolerance: 0.6 ns to 1 ns
Current at 30 ns Tolerance: I 30 ns +/- 30%
Current at 60 ns Tolerance: I 60 ns +/- 30%

From Standard				From Calibration Certificate						
2kV	First Peak Current	Current at 30ns	Current at 60ns		Measured First Peak Current	1st Peak Worst case +5%	Measured Current at 30ns	30ns Worst case +5%	Measured Current at 60ns	60ns Worst case +5%
Nominal	7.5	4.0	2.0	Positive	6.8	7.2	3.6	3.8	1.9	2.0
Min	6.4	2.8	1.4	Negative	-6.7	-7.0	-3.6	-3.8	-1.8	-1.9
Max	8.6	5.2	2.6	Min.		6.4		2.8		1.4
Tolerance in%	0.2	0.3	0.3	Max.		8.6		5.2		2.6

4kV	First Peak Current	Current at 30ns	Current at 60ns		Measured First Peak Current	1st Peak Worst case +5%	Measured Current at 30ns	30ns Worst case +5%	Measured Current at 60ns	60ns Worst case +5%
Nominal	15.0	8.0	4.0	Positive	13.3	14.0	7.7	8.1	4.1	4.3
Min.	12.8	5.6	2.8	Negative	-13.3	-14.0	-7.5	-7.8	-4.0	-4.2
Max.	17.3	10.4	5.2	Min.		12.8		5.6		2.8
Tolerance in %	0.2	0.3	0.3	Max.		17.3		10.4		5.2

6kV	First Peak Current	Current at 30ns	Current at 60ns		Measured First Peak Current	1st Peak Worst case +5%	Measured Current at 30ns	30ns Worst case +5%	Measured Current at 60ns	60ns Worst case +5%
Nominal	22.5	12.0	6.0	Positive	19.9	20.9	12.0	12.5	6.3	6.6
Min.	19.1	8.4	4.2	Negative	-20.2	-21.2	-12.0	-12.6	-6.2	-6.6
Max.	25.9	15.6	7.8	Min.		19.1		8.4		4.2
Tolerance in %	0.2	0.3	0.3	Max.		25.9		15.6		7.8

8kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	30.0	16.0	8.0
Min.	25.5	11.2	5.6
Max.	34.5	20.8	10.4
Tolerance in %	0.2	0.3	0.3

	Measured First Peak Current	1st Peak Worst case +5%	Measured Current at 30ns	30ns Worst case +5%	Measured Current at 60ns	60ns Worst case +5%
Positive	27.1	28.4	16.4	17.2	8.6	9.1
Negative	-27.2	-28.5	-16.5	-17.3	8.7	9.1
Min.		25.5		11.2		5.6
Max.		34.5		20.8		10.4

Standard Parameters					Calculated Range		
Indicated Voltage	Polarity	Tolerance (%)	Max.	Min.	Calibration Certificate	Max.	Min.
2.0	Positive	15.0	2.3	1.7	2.0	2.0	2.0
	Negative	15.0	2.3	1.7	-2.1	-2.6	-2.6
4.0	Positive	15.0	4.6	3.4	4.0	4.0	4.0
	Negative	15.0	4.6	3.4	-4.1	-4.1	-4.1
6.0	Positive	15.0	6.9	5.1	6.0	6.0	6.0
	Negative	15.0	6.9	5.1	-6.1	-6.1	-6.1
8.0	Positive	15.0	9.2	6.8	8.0	8.0	7.9
	Negative	15.0	9.2	6.8	-8.1	-8.1	-8.1
15.0	Positive	15.0	17.3	12.8	15.2	15.2	15.2
	Negative	15.0	17.3	12.8	-14.9	-14.9	-14.9

It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95% confidence

- **RF Radiated Immunity (IEC 61000-4-3)**

For 80MHz to 6,000 MHz:

Level setting uncertainty=1.7 dB

It has been demonstrated that the RS generator meets the specified requirements in the standard with at least a 95% confidence.

● EFT/BURST Immunity (IEC 61000-4-4)

EFT Output Voltage Check：

Voltage Peak Tolerance：Expected ±10% for 50Ω & Expected ±20% for 1kΩ

(10/90%)Rise Time T1 Tolerance：5ns ±30%

(50/50%)Duration Time T2 Tolerance：50ns±30% for 50Ω &35ns~150ns for 1kΩ

Voltage

Impedance	Voltage Setting(V)	Expected (kV)	Actual (kV)	Uncertainty (%)	T1	Uncertainty (%)	T2	Uncertainty (%)
50Ω	500	250	258	6.2	4	5.1	41.64	5.1
50Ω	1000	500	538	6	4.03	5.1	41.57	5.1
50Ω	2000	1000	1070	6	4.18	5.1	42.99	5.1
50Ω	4000	2000	2006	6	5.01	5.1	50.41	5.1
50Ω	-500	-250	-245	6.4	4.01	5.1	42.1	5.1
50Ω	-1000	-500	-522	6.1	3.96	5.1	41.92	5.1
50Ω	-2000	-1000	-1019	6	4.1	5.1	43.39	5.1
50Ω	-4000	-2000	-1935	6	4.86	5.1	49.81	5.1
1kΩ	500	475	501	6.1	3.86	5.1	55.21	5.1
1kΩ	1000	950	1048	6	3.95	5.1	54.13	5.1
1kΩ	2000	1900	2087	6	4.06	5.1	55.17	5.1
1kΩ	4000	3800	3834	6	4.69	5.1	63.36	5.1
1kΩ	-500	-475	-487	6.1	3.85	5.1	53.95	5.1
1kΩ	-1000	-950	-1023	6	3.97	5.1	52.59	5.1
1kΩ	-2000	-1900	-2023	6	4.05	5.1	55.49	5.1
1kΩ	-4000	-3800	-3753	6	4.49	5.1	57.01	5.1

EFT Repetition Frequency (Voltage @ 1 kV)

Setting (kHz)	Actual (kHz)	Uncertainty (%)	Tolerance (%)
5	5.03	5.1	20%
100	104.77	5.1	20%

Burst Duration (Voltage @ 1 kV)

Setting (ms)	Repetition Freq. (kHz)	Actual (ms)	Uncertainty (%)	Tolerance (%)
15	5	14.8	5.1	20%
0.75	100	0.79	8.1	20%

Burst Period (Voltage @ 1 kV)

Setting (ms)	Repetition Freq. (kHz)	Actual (ms)	Uncertainty (%)	Tolerance (%)
300	5	296.5	5.1	20%
300	100	296.5	5.1	20%

It has been demonstrated that the EFT/BURST generator meets the specified requirements in the standard with at least a 95% confidence.

● Surge Immunity (IEC 61000-4-5)

Surge (1.2/50)Open Circuit Output Voltage Waveform Check：

Voltage Peak Tolerance ：Setting ±10%

T3 Front Time (30/90%)*1.67 Tolerance ：1.2us±30%

T4 Time to Half Tolerance ：50μs±20% for 2-ohm & 25μs~60μs for 12 ohm Waveform

Impedance	Voltage Setting(V)	Actual (kV)	Uncertainty (%)	T3	Uncertainty (%)	T4	Uncertainty (%)
L-N 2Ω	500	506	5.6	1.22	4.6	47.27	4.6
L-N 2Ω	4000	4092	5.6	1.27	4.6	46.8	4.6
L-N 2Ω	-500	-509	5.6	1.28	4.6	46.73	4.6
L-N 2Ω	-4000	-4188	5.6	1.17	4.6	46.7	4.6
L-G 12Ω	500	503	5.6	1.05	4.7	30.1	4.6
L-G 12Ω	4000	4044	5.6	1.09	4.6	30.31	4.6
L-G 12Ω	-500	-502	5.6	1.09	4.7	30.4	4.6
L-G 12Ω	-4000	-4116	5.6	1.06	4.6	29.67	4.6
N-G 12Ω	500	500	5.6	0.98	4.6	29.85	4.6
N-G 12Ω	4000	4044	5.6	1.05	4.6	29.28	4.6
N-G 12Ω	-500	-503	5.6	1.07	4.6	29.73	4.6
N-G 12Ω	-4000	-4116	5.6	1.08	4.6	28.93	4.6
Impulse	500	502	5.6	1.06	4.6	57.01	4.6
Impulse	1000	1023	5.6	1.1	4.7	56.97	4.6
Impulse	2000	2022	5.6	1.05	4.6	57.52	4.6
Impulse	4000	4020	5.6	1.01	4.6	57.13	4.6
Impulse	-500	-503	5.6	1.08	4.5	57.97	4.6
Impulse	-1000	-1029	5.6	1.11	4.6	58.27	4.6
Impulse	-2000	-2046	5.6	1.05	4.6	58.87	4.6
Impulse	-4000	-4116	5.6	1.02	4.6	58.47	4.6

Surge (1.2/50)Short Circuit Output Voltage Waveform Check：

Current Peak Tolerance ：Ipeak ±10%

T5 Front Time (10/90%)*1.25Tolerance ：8.0us±20% for 2-ohm & 2.5μs±30% for 12 ohm Waveform

T6 Time to Half Tolerance ：20μs±20% for 2-ohm & 25μs±30% for 12 ohm Waveform

Impedance	Voltage Setting(V)	Actual (kV)	Uncertainty (%)	T5	Uncertainty (%)	T6	Uncertainty (%)
L-N 2Ω	500	245	4.8	6.81	3.4	18.29	3.4
L-N 2Ω	4000	2040	4.8	6.64	3.4	18.13	3.4
L-N 2Ω	-500	-244	4.8	6.62	3.4	18.18	3.4
L-N 2Ω	-4000	-2052	4.8	6.61	3.3	18.02	3.4
L-G 12Ω	500	42	4.8	1.79	3.4	27.18	3.4
L-G 12Ω	4000	352	4.8	1.89	3.4	27.89	3.4
L-G 12Ω	-500	-42	4.8	1.76	3.4	26.71	3.4
L-G 12Ω	-4000	-350	4.8	1.78	3.4	25.8	3.4
N-G 12Ω	500	42	4.8	1.81	3.4	26.25	3.4
N-G 12Ω	4000	350	4.8	1.78	3.3	25.27	3.4
N-G 12Ω	-500	-43	4.8	1.76	3.4	25.85	3.4
N-G 12Ω	-4000	-346	4.8	1.86	3.4	26.38	3.4
Impulse	500	251	4.8	6.46	3.4	17.73	3.4
Impulse	1000	510	4.8	6.42	3.4	17.76	3.4
Impulse	2000	1038	4.8	6.42	3.4	17.61	3.4
Impulse	4000	2088	4.8	6.59	3.4	17.59	3.4
Impulse	-500	-251	4.8	6.51	3.3	17.76	3.4
Impulse	-1000	-513	4.8	6.52	3.4	17.59	3.4
Impulse	-2000	-1038	4.8	6.46	3.4	17.63	3.4
Impulse	-4000	-2100	4.8	6.46	3.4	17.68	3.4

It has been demonstrated that the Surge generator meets the specified requirements in the standard with at least a 95% confidence.

● RF Conducted Immunity (IEC 61000-4-6)

Conducted Disturbances Induced by Radio-Frequency Field Immunity (CS)

RF Frequency Measurement Check		RF Generator Second Harmonic Check
Reading	Standard	Harmonic (dBc)
9.000 kHz	8.999932352 kHz	-48.5
50.000 kHz	49.999631038 kHz	-46
100.000 kHz	99.99926231kHz	-45.3
1.000000 MHz	0.999992578kHz	-47.3
5.000000 MHz	4.999963131MHz	-56.3
10.000000 MHz	9.999926273MHz	-57.9
50.000000 MHz	49.99963240 MHz	-63.2
100.000000 MHz	99.99926524 MHz	-61.6
500.000000 MHz	499.9963287 MHz	-65.7
1000.000000 MHz	999.9926588 MHz	-72.9

RF Generator AM Modulation Measurement Check (1 kHz ; 80 %)			
Frequency	Mod. Freq.	Reading	Standard
100.000 kHz	1 kHz	80.00%	80.30%
1.000000 MHz	1 kHz	80.00%	81.30%
5.000000 MHz	1 kHz	80.00%	81.40%
10.000000 MHz	1 kHz	80.00%	81.40%
50.000000 MHz	1 kHz	80.00%	81.30%
100.000000 MHz	1 kHz	80.00%	81.30%
500.000000 MHz	1 kHz	80.00%	81.90%
1000.000000 MHz	1 kHz	80.00%	81.30%

RF Generator Response and Accuracy Measurement Check		
Frequency	Reading (dBm)	Standard (dBm)
9.000 kHz	0	-0.15
50.000 kHz	0	0.16
100.000 kHz	0	0.19
1.000000 MHz	0	0.21
5.000000 MHz	0	0.22
10.000000 MHz	0	0.19
50.000000 MHz	0	-0.11
50.000000 MHz	-10	-10.18
50.000000 MHz	-20	-20.31
50.000000 MHz	-30	-30.38
50.000000 MHz	-40	-40.55
50.000000 MHz	-50	-50.61
100.000000 MHz	0	0.18
500.000000 MHz	0	0.3
1000.000000 MHz	0	0.25

RF Power Meter Measurement Check			
Frequency (MHz)		Standard (dBm)	Reading (dBm)
CH 1	50	10	10.19
CH 1	50	0	0.17
CH 1	50	-10	-9.8
CH 1	50	-15	-14.78
CH 2	50	10	10.13
CH 2	50	0	0.1
CH 2	50	-10	-9.88
CH 2	50	-15	-14.9
CH 3	50	10	10.16
CH 3	50	0	0.13
CH 3	50	-10	-9.85
CH 3	50	-15	-14.86

Power Amplifier Gain Flatness Measurement		Power Amplifier Standard Measurement (Input: 0 dBm)		Power Amplifier Second Harmonic Measurement Check
Frequency	Reading (dB)	Result (dBm)	Spec. (dBm)	Reading (dBc)
150.000 kHz	51.7	50.7	>45.44	-50.7
1.000000 MHz	51.9	55.1	>45.44	-49.2
5.000000 MHz	51.8	51.2	>45.44	-54.5
10.000000 MHz	51.8	51.2	>45.44	-55.6
50.000000 MHz	51.7	51.2	>45.44	-53.8
100.000000 MHz	52.1	50.5	>45.44	-51.1
200.000000 MHz	53.1	50.9	>45.44	-55.4
230.000000 MHz	52.7	49.6	>45.44	-53.8

Uncertainty: Frequency: 1.2×10^{-7}
RF Power Level: 0.68 dB
Harmonic: 0.74 dB

It has been demonstrated that the CS generator meets the specified requirements in the standard with at least a 95% confidence.

● Magnetic Field Immunity (IEC 61000-4-8)

Power Frequency Magnetic Field Immunity

AC Current Accuracy Check

Freq (Hz)	Range (A)	Standard (A)	Reading (A)	Uncertainty (%)
50	0~10	1.038	1	0.3
50	0~10	3.091	3	0.3
50	0~10	10.254	10	0.3
50	10~125	10.183	10	0.3
50	10~125	30.45	30	0.3
50	10~125	101.23	100	0.3
60	0~10	1.06	1	0.3
60	0~10	3.26	3	0.3
60	0~10	10.85	10	0.3
60	10~125	10.9	10	0.3
60	10~125	32.6	30	0.3
60	10~125	108.8	100	0.3

Magnetic Measurement Check：(@50Hz)

Range (A)	Standard (A/m)	Reading (A)	Uncertainty (%)
0~10	1	1.06	1
0~10	3	3.26	1
0~10	10	10.85	1
10~125	10	10.9	1
10~125	30	32.6	1
10~125	100	108.8	1

It has been demonstrated that the PFMF the specified requirements in the standard with at least a 95% confidence.

● Voltage Variation Immunity (IEC 61000-4-11)

Voltage Dips and Voltage Interruptions Immunity

PQF Measurement: (Input Voltage: 230V/50Hz)

Level	Load	Actual (V)	Uncertainty (mV/V)	Tolerance (%)
80%	100Ω	182.9	17	184 +/- 5%
70%	100Ω	160.1	17	161 +/- 5%
40%	100Ω	93	17	92 +/- 5%
0%	100Ω	5.7	17	----

VAR Check: (Input Voltage: 230V/50Hz)

Level	Load	Actual (V)	Uncertainty (mV/V)	Tolerance (%)
80%	100Ω	183.9	17	184 +/- 5%
70%	100Ω	159.5	17	161 +/- 5%
40%	100Ω	92.2	17	92 +/- 5%
0%	100Ω	5.4	17	----

It has been demonstrated that the Dip generator meets the specified requirements in the standard with at least a 95% confidence.

7. List of Measuring Equipment Used

Conducted Emission - Test Date: 16/Dec/2019

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Receiver	R&S	ESR3	102318	9K Hz – 3.6 GHz	30/Jul/2019	Conduction (CO01-NH)
LISN	SCHAFFNER	NNB41	06/10024	9kHz - 30MHz	02/Jan/2019	Conduction (CO01-NH)
Power Filter	CORCOM	MR12030	N/A	30A*2	NCR	Conduction (CO01-NH)
RF Cable-CON	Suhner Switzerland	RG223/U	CB004	9kHz - 30MHz	27/Dec/2018	Conduction (CO01-NH)
software	Audix	E3	6.12160806	-	NCR	Conduction (CO01-NH)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

Radiated Emission below 1GHz - Test Date: 16/Dec/2019

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Open Area Test Site	SPORTON	OATS-10	OS02-NH	30 MHz - 1 GHz 10m, 3m	09/Mar/2019	Radiation (OS02-NH)
Amplifier	HP	8447D	2944A06292	0.1 MHz - 1.3 GHz	07/May/2019	Radiation (OS02-NH)
Receiver	R&S	ESCI	100497	9 kHz – 3 GHz	10/May/2019	Radiation (OS02-NH)
Bilog Antenna With 5dB Attenuator	TESEO	CBL6112D	35376	30 MHz - 2 GHz	27/Apr/2019	Radiation (OS02-NH)
Turn Table	EMCO	2080	9508-1805	0 - 360 degree	NCR	Radiation (OS02-NH)
Antenna Mast	ETS	2075-2	2385	1 m - 4 m	NCR	Radiation (OS02-NH)
RF Cable-R10m	MIYAZAKI	5DFB	CB044	30 MHz - 1 GHz	26/Aug/2019	Radiation (OS02-NH)
Software	Audix	E3	Ver.4	-	NCR	Radiation (OS02-NH)

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

EMS EN55024 - Test Date: 28/Apr/2020 ~ 29/Apr2020

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	TESEQ	NSG 437	192	Air: 0 ~ 30kV Contact: 0 ~ 30kV	04/Oct/2019	ESD
EMC Immunity Test System	TESEQ	CDN 3061	1413	0 ~ 4.8kV	17/Jan/2020	EFT
Software	Teseq AG	NSG3000	Version 1.3.2	-	NCR	EFT
EMC Immunity Test System	TESEQ	NSG 3060	1435	0 ~ 6 kV/2Ω 0 ~ 6 kV/12Ω	17/Jan/2020	Surge
Software	Teseq AG	NSG3000	Version 1.3.2	-	NCR	Surge
EMC Immunity test System	TESEQ	NSG 4070B-35	42289	9kHz ~ 1GHz	12/Sep/2019	CS
Attenuator	Bird	75-A-FFN-06	1732	150kHz ~ 230MHz	23/Sep/2019	CS
Coupling And Decoupling Network	SCHAFFNER	CDN M016	16676	150kHz ~ 230MHz	09/Jul/2019	CS
Software	TESEQ	NSG4070	Version(1.2.0)	-	NCR	CS
Magnetic field Immunity Loop	FCC (KEYTEK)	F-1000-4-8/9/10-L-1M	05004, 03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	09/Oct/2019	Magnetic
Magnetic Generator	FCC (KEYTEK)	F-1000-4-8-G-125A	05004, 03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	09/Oct/2019	Magnetic
DIP Generator (EMC Immunity Test System)	TESEQ	VAR 3005-S16	804	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	17/Jan/2020	DIP
Software	Teseq AG	NSG3000	Version 1.3.2	-	NCR	DIP
Harmonic/Flicker Test System	TESEQ	CCN1000-1	72471	4000VA 16A PEAK	01/Apr/2020	Harmonic/Flicker
AC Power Source	TESEQ	NSG 1007-5	1510A00144	16A PEAK	01/Apr/2020	Harmonic/Flicker
Software	TESEQ	Win2100v4	Version4.6.0(2014)	-	NCR	Harmonic/Flicker

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

EMS EN55024 RS - Test Date: 04/May/2020

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Signal Generator	ROHDE&SCHWARZ	SMB100A	108589	9kHz ~ 6GHz	21/Apr/2020	RS
Power Amplifier	MILMEGA	80RF1000-300	1079234	80MHz ~ 1GHz, 300W	NCR	RS
AMPLIFIER CONTROLLER	MILMEGA	AC-001	N/A	N/A	NCR	RS
Antenna	AR	ATL80M1G	348541	80MHz ~ 1GHz, 30W	NCR	RS
EPM Series Power Meter	KEYSIGHT	N1914A	MY57070002	9 kHz to 110 GHz	21/Apr/2020	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57020004	9kHz ~ 6GHz	20/Apr/2020	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57030009	9kHz ~ 6GHz	20/Apr/2020	RS
Fiber Optic modem	ETS-LINDGREN	HI-4413P	N/A	N/A	NCR	RS
Dual Directional Coupler	WERLATONE	C10117-10	112093	N/A	NCR	RS
Dual Directional Coupler	WERLATONE	C3908-10	112109	N/A	NCR	RS
RS immunity Test system	Sporton combination	Sporton RS	RS06HY	3V/m , 80MHz ~ 6GHz	19/Sep/2019	RS
RF-SWITCH NETWORK	TESEQ	RFB 2000	45818	N/A	NCR	RS
Probe	ETS-LINDGREN	HI-6005	00052473	0.1 MHz - 6 GHz	10/May/2019	RS
Software	Audix	i2	Version:5	-	NCR	RS

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

EMS EN55035- Test Date: 18/Dec/2019 ~ 23/Dec/2019

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	NoiseKen	ESS-B3011A	ESS1889000	Air: 0 ~ 30kV Contact: 0 ~ 30kV	12/Mar/2019	ESD
Advanced EMC Immunity Test System	KeyTek	EMCPro	609221	0 KV - 4.4 KV, 0 KV -6 KV/2Ω, 230VA/50Hz/60Hz	19/Sep/2019	EFT
Software	KetTek	CEWare32	Version 4.1	-	NCR	EFT
Advanced EMC Immunity Test System	KeyTek	EMCPro	609221	0 KV - 4.4 KV, 0 KV -6 KV/2Ω, 230VA/50Hz/60Hz	19/Sep/2019	Surge
Software	KetTek	CEWare32	Version 4.1	-	NCR	Surge
EMC Immunity test System	TESEQ	NSG 4070B-35	42289	9kHz ~ 1GHz	12/Sep/2019	CS
Attenuator	Bird	75-A-FFN-06	1732	150kHz ~ 230MHz	23/Sep/2019	CS
Coupling And Decoupling Network	SCHAFFNER	CDN M016	16676	150kHz ~ 230MHz	09/Jul/2019	CS
Software	TESEQ	NSG4070	Version(1.2.0)	-	NCR	CS
Magnetic field Immunity Loop	FCC (KEYTEK)	F-1000-4-8/9/10-L-1M	05004, 03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	09/Oct/2019	Magnetic
Magnetic Generator	FCC (KEYTEK)	F-1000-4-8-G-125A	05004, 03004	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	09/Oct/2019	Magnetic
Advanced EMC Immunity Test System	KeyTek	EMCPro	609221	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	19/Sep/2019	DIP
Software	KetTek	CEWare32	Version 4.1	-	NCR	DIP
Harmonic/Flicker Test System	TESEQ	CCN1000-1	72471	4000VA 16A PEAK	01/Apr/2019	Harmonic/Flicker
AC Power Source	TESEQ	NSG 1007-5	1510A00144	16A PEAK	01/Apr/2019	Harmonic/Flicker
Software	TESEQ	Win2100v4	Version4.6.0(2014)	-	NCR	Harmonic/Flicker

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

EMS EN55035 RS- Test Date: 24/Dec/2019

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Signal Generator	ROHDE&SCHWARZ	SMB100A	108589	9kHz ~ 6GHz	14/May/2019	RS
Power Amplifier	MILMEGA	80RF1000-300	1079234	80MHz ~ 1GHz, 300W	NCR	RS
Power Amplifier	MILMEGA	AS0860B-50/50	1079525	0.8 ~ 6GHz ,50W(0.8GHz~2GHz and 1.8GHz~6.0GHz)	NCR	RS
AMPLIFIER CONTROLLER	MILMEGA	AC-001	N/A	N/A	NCR	RS
Antenna	AR	ATL80M1G	348541	80MHz ~ 1GHz, 30W	NCR	RS
Antenna	SCHWARZBECK	STLP 9149	STLP9149 #490	700MHz ~ 10.5GHz	NCR	RS
EPM Series Power Meter	KEYSIGHT	N1914A	MY57070002	9 kHz to 110 GHz	24/Apr/2019	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57020004	9kHz ~ 6GHz	24/Apr/2019	RS
Avg Power Sensor	KEYSIGHT	E9304A	MY57030009	9kHz ~ 6GHz	24/Apr/2019	RS
Fiber Optic modem	ETS-LINDGREN	HI-4413P	N/A	N/A	NCR	RS
Dual Directional Coupler	WERLATONE	C10117-10	112093	N/A	NCR	RS
Dual Directional Coupler	WERLATONE	C3908-10	112109	N/A	NCR	RS
RS immunity Test system	Sporton combination	Sporton RS	RS06HY	3V/m , 80MHz ~ 6GHz	19/Sep/2019	RS
RF-SWITCH NETWORK	TESEQ	RFB 2000	45818	N/A	NCR	RS
Probe	ETS-LINDGREN	HI-6005	00052473	0.1 MHz - 6 GHz	10/May/2019	RS
Software	Audix	i2	Version:5	-	NCR	RS

Note: Calibration Interval of instruments listed above is one year. NCR: No Calibration Request.

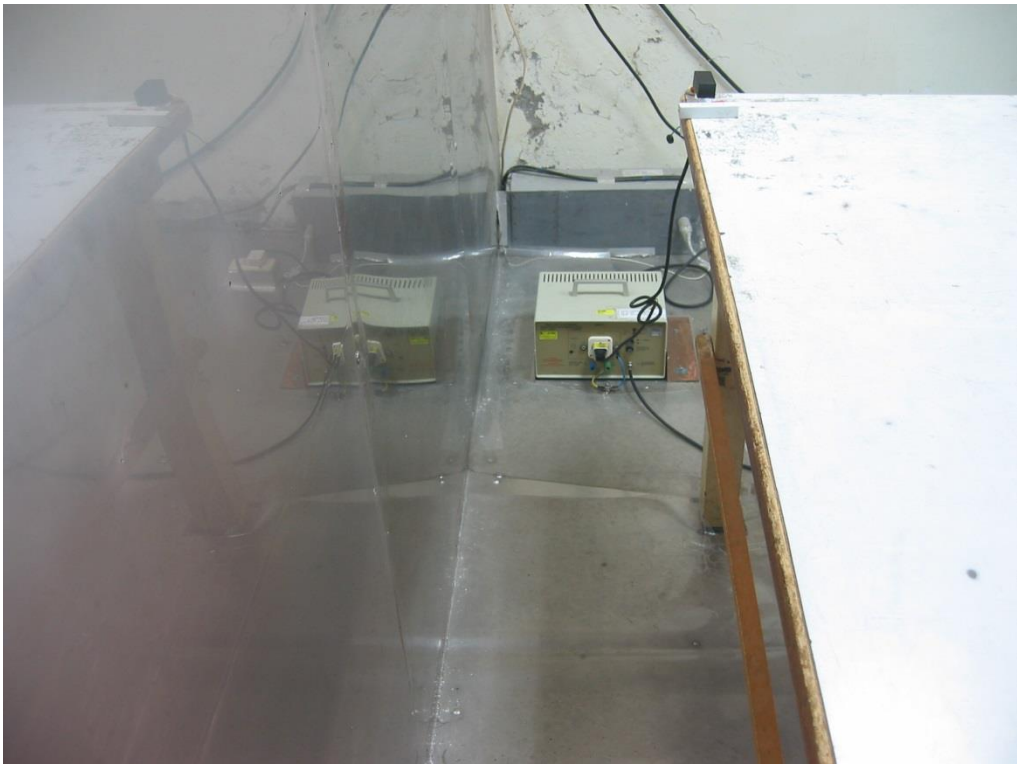
Appendix A. Test Photos

1. Photographs of Conducted Emissions Test Configuration

Mode 1

Front View

Side View

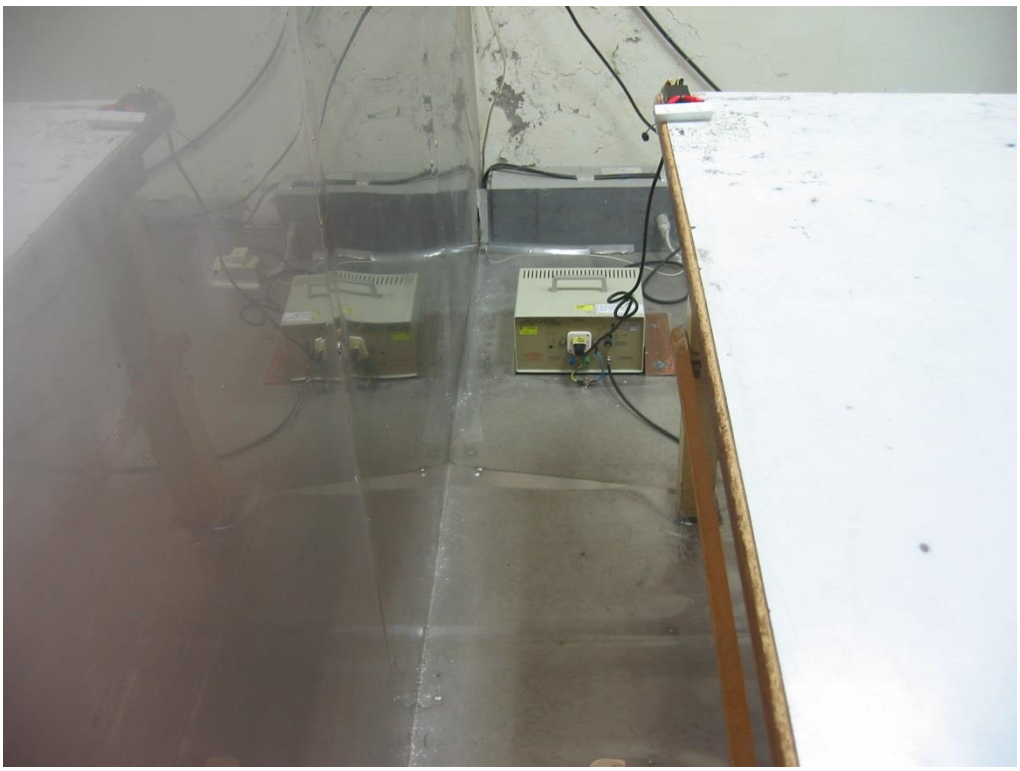


Under Table View

Mode 2

Front View

Side View

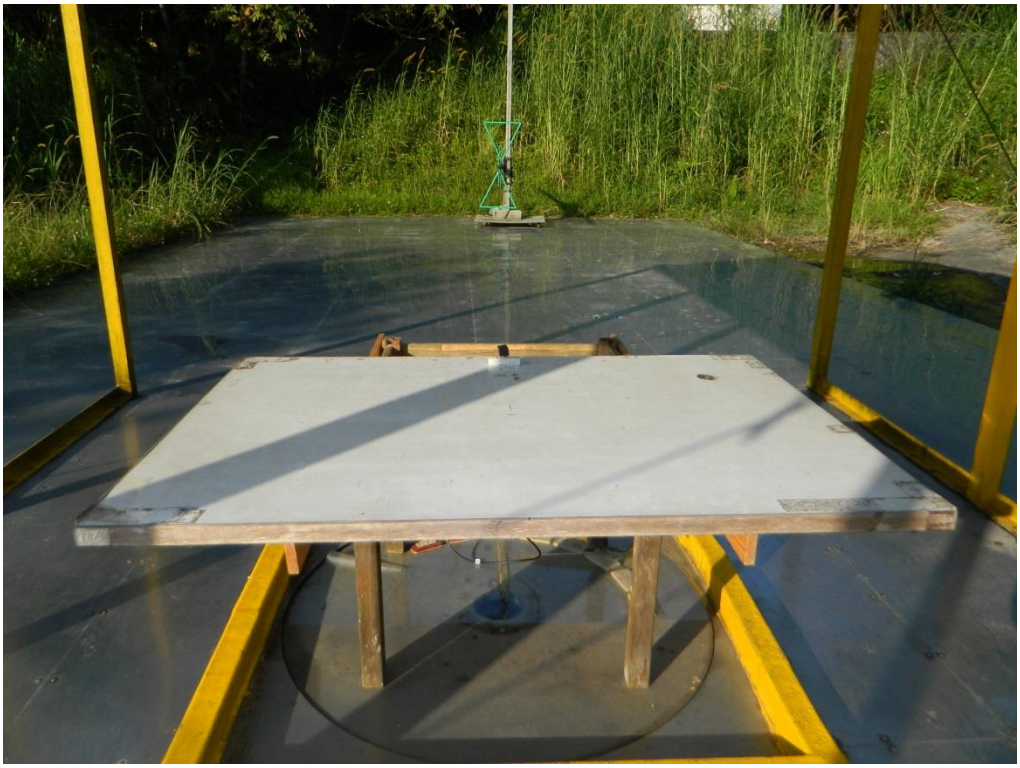


Under Table View

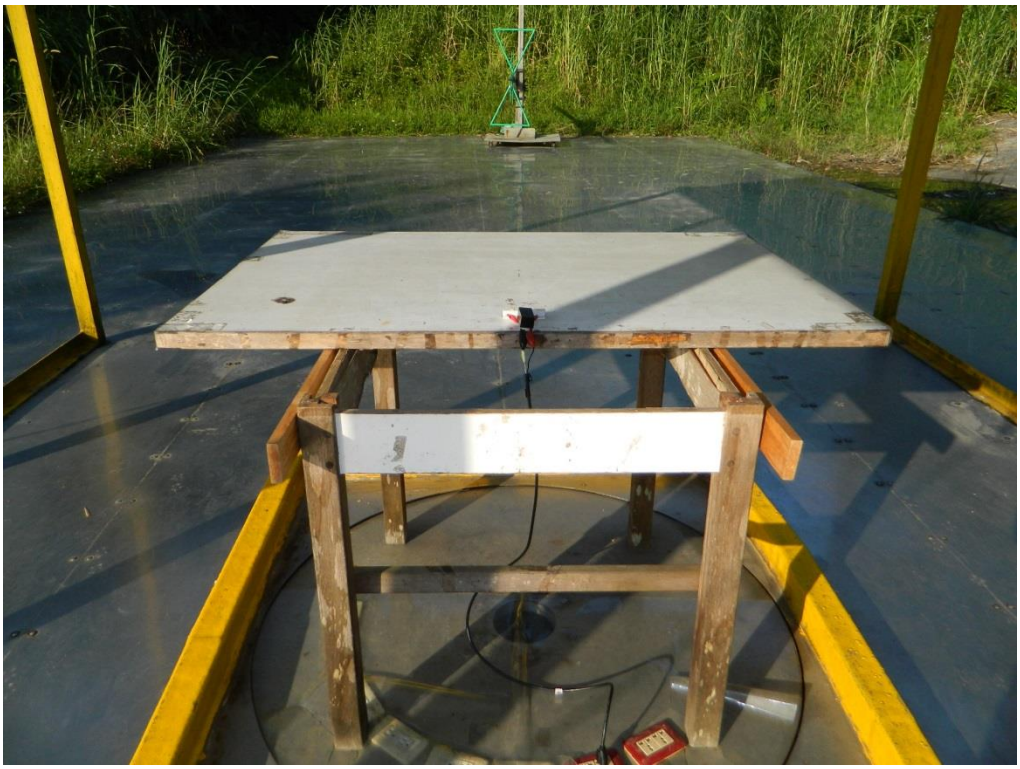
2. Photographs of Radiated Emissions Test Configuration

For radiated emissions below 1GHz
Mode 1

Front View

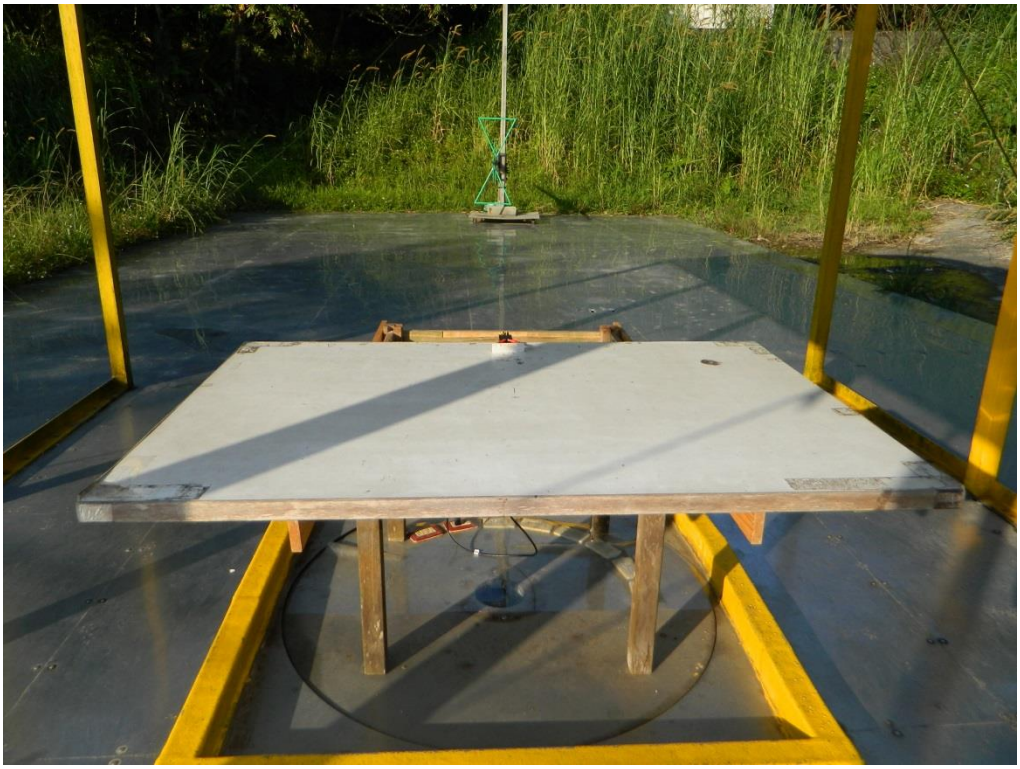


Rear View

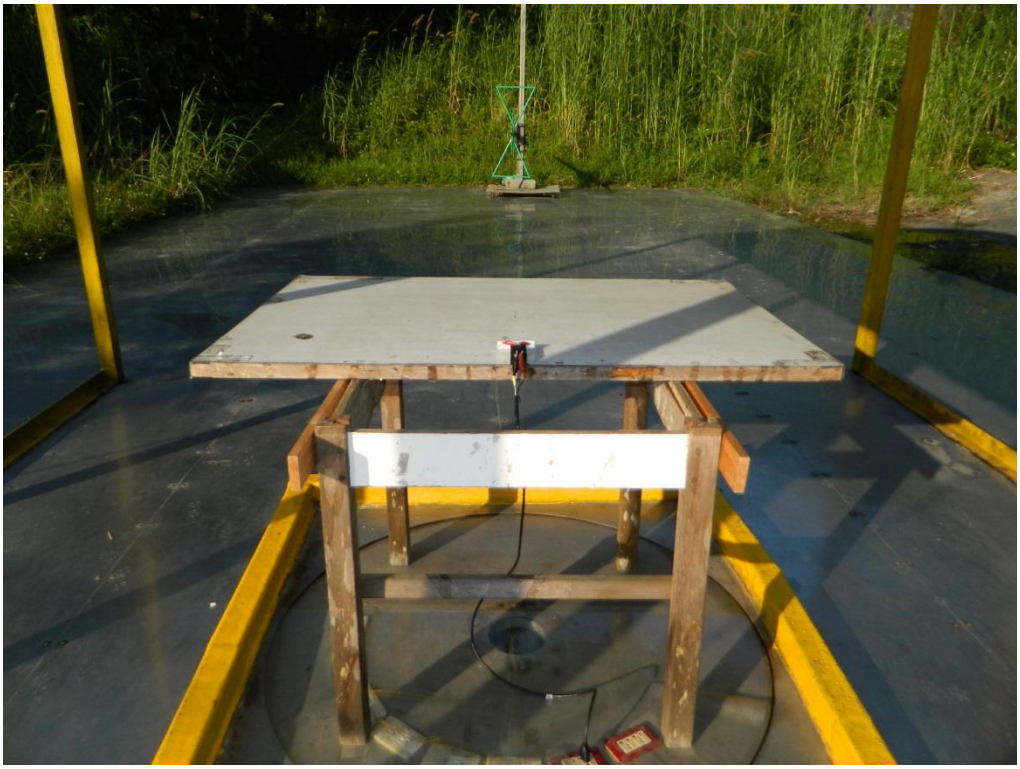


Mode 2

Front View



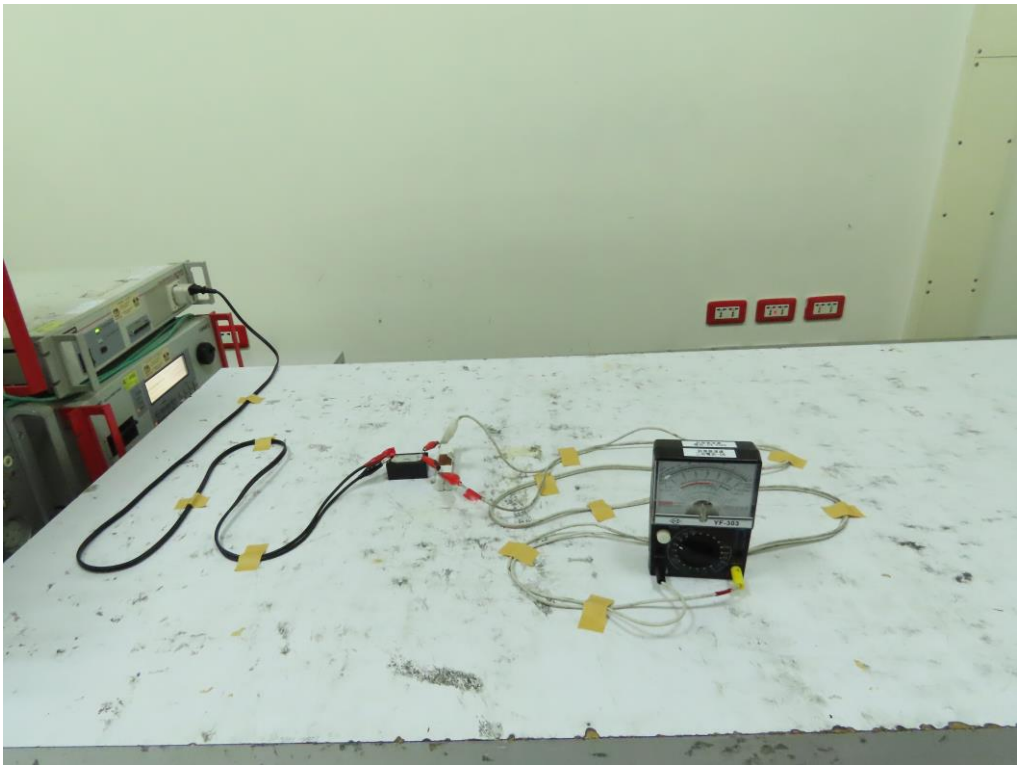
Rear View



3. Photographs of Harmonic, Flicker Test Configuration

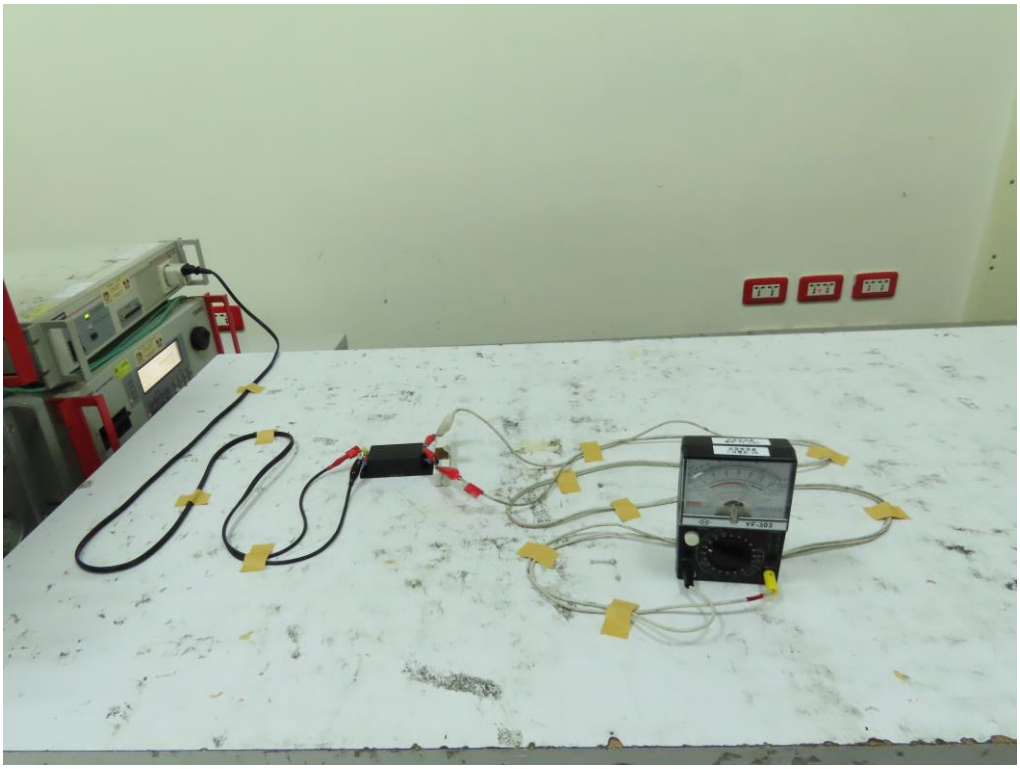
EN55024
Mode 1

Front View



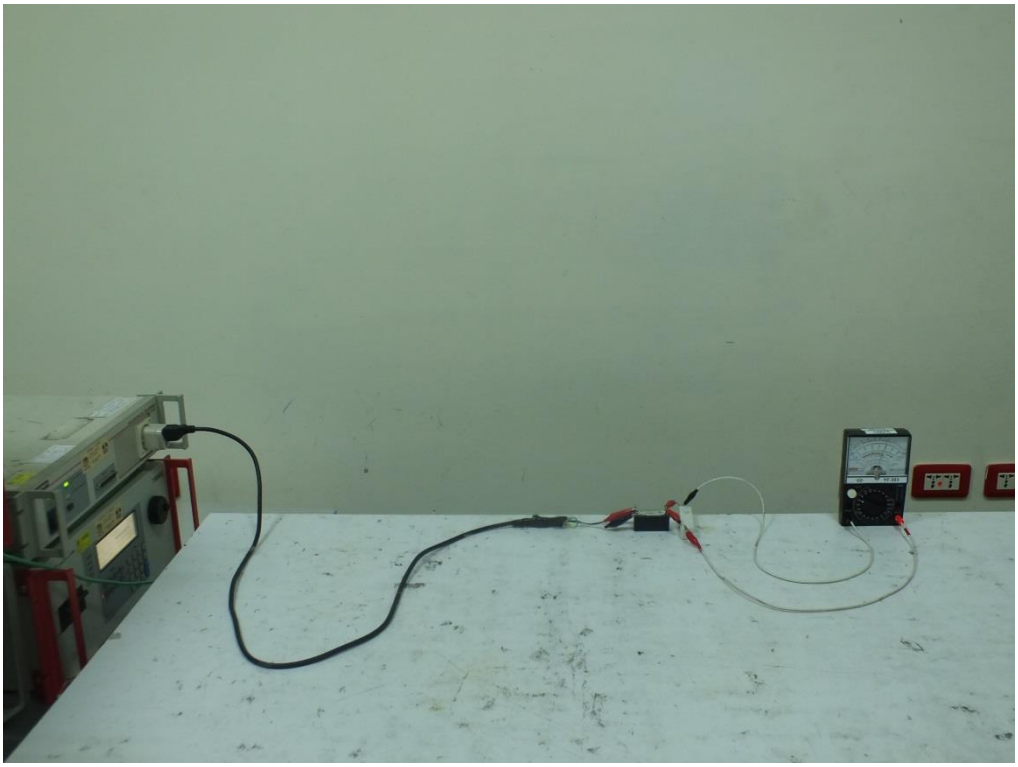
Mode 2

Front View



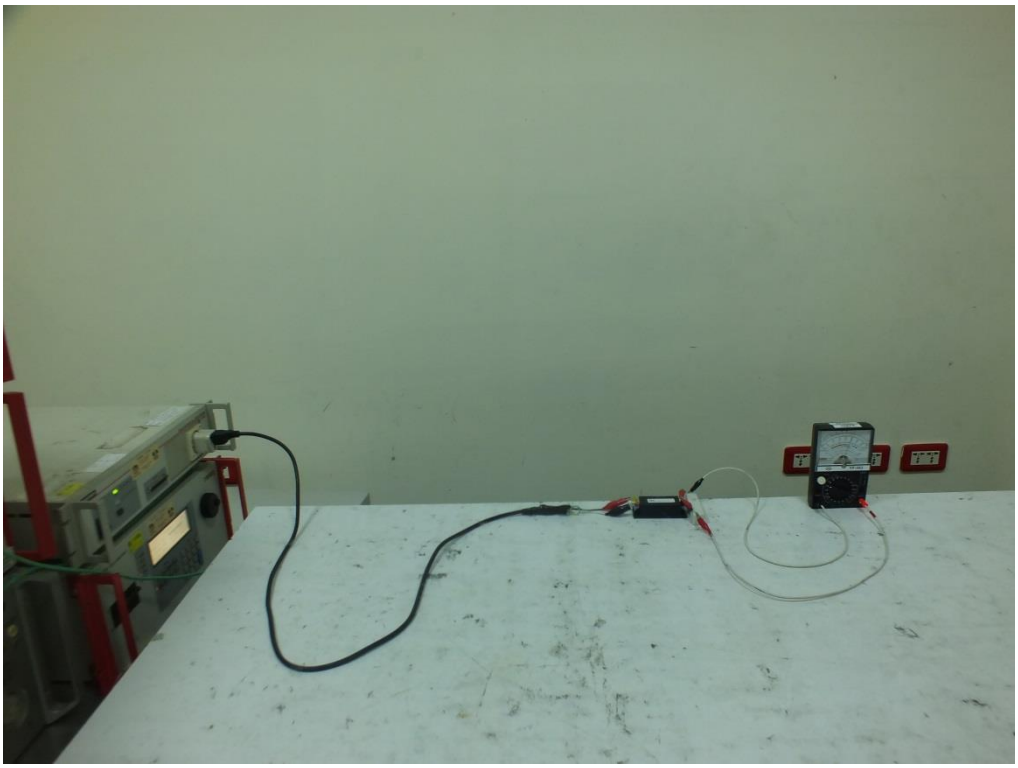
EN55035
Mode 1

Front View



Mode 2

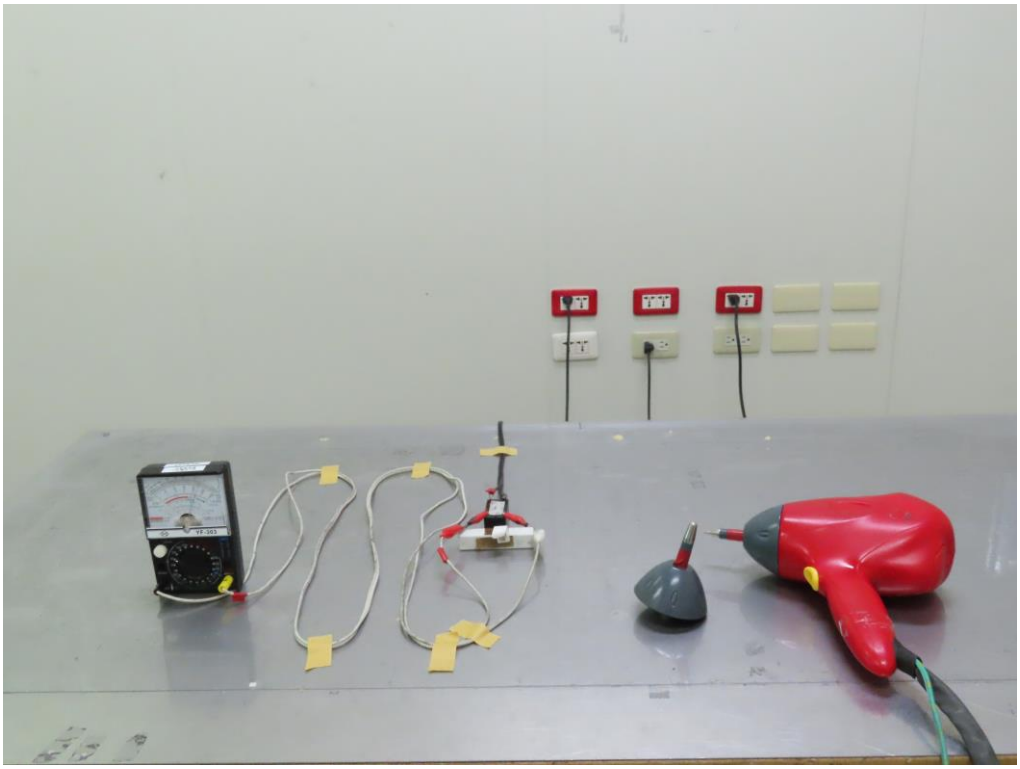
Front View



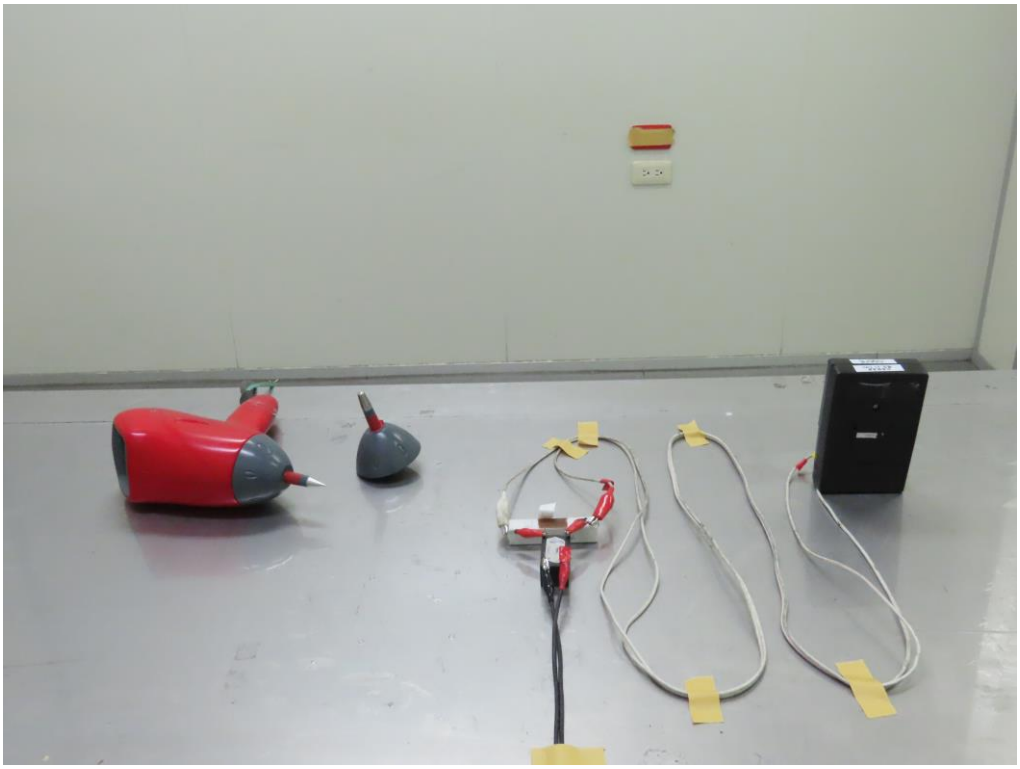
4. Photographs of ESD Immunity Test Configuration

EN55024
Mode 1

Front View

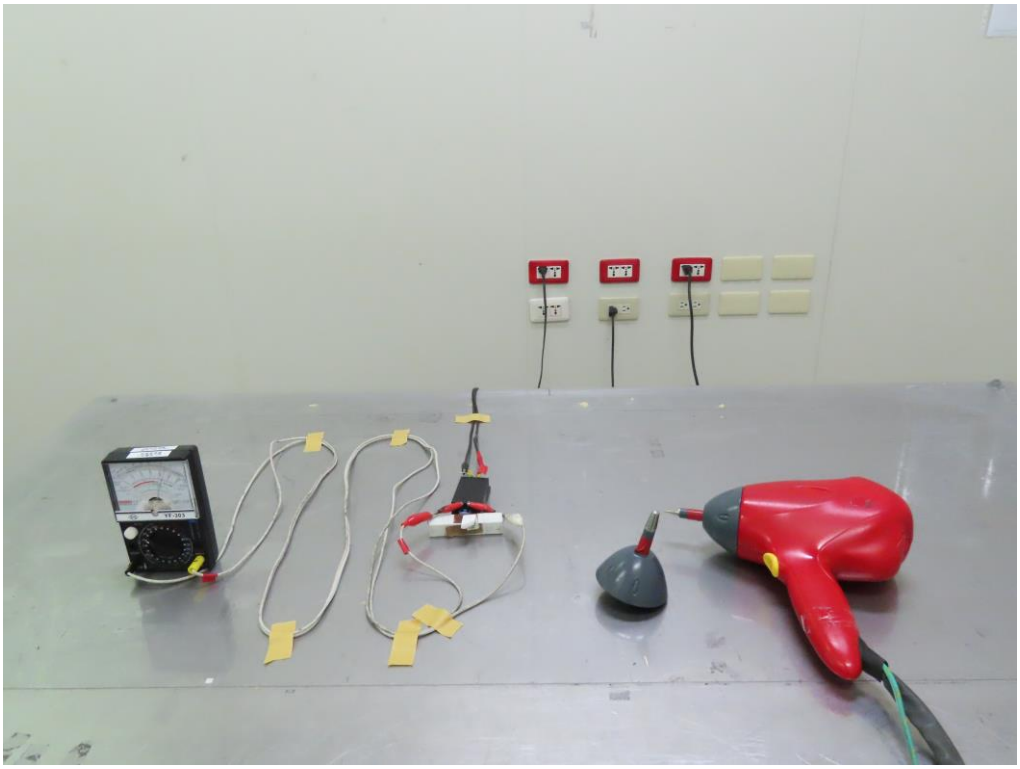


Rear View

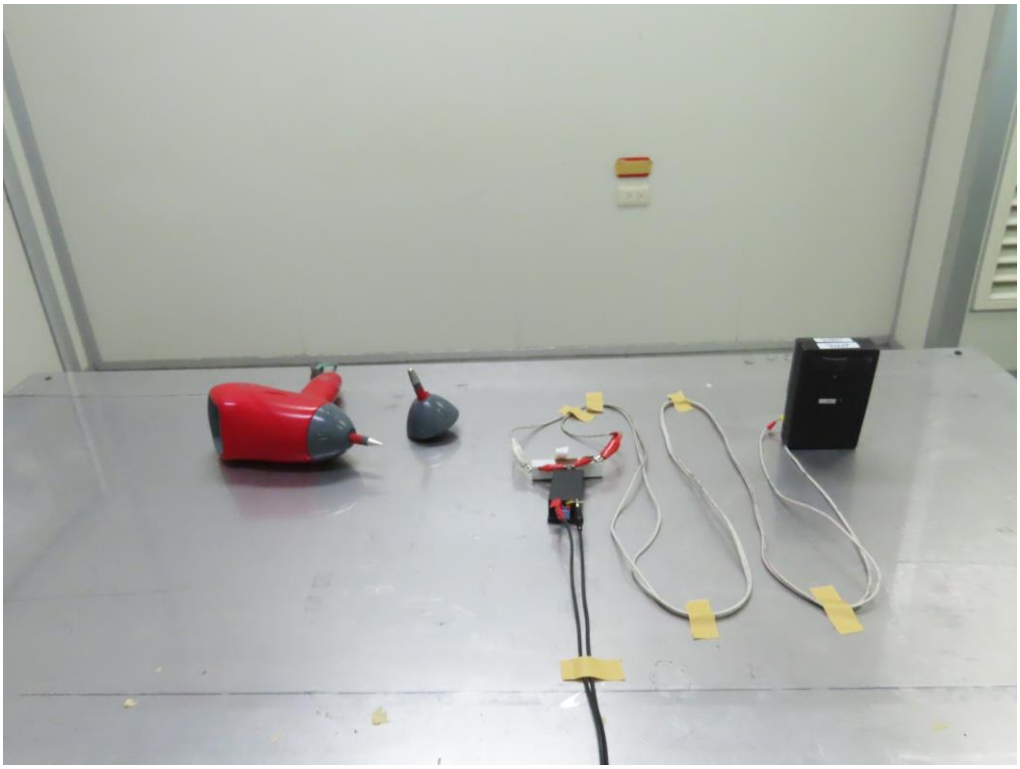


EN55024
Mode 2

Front View



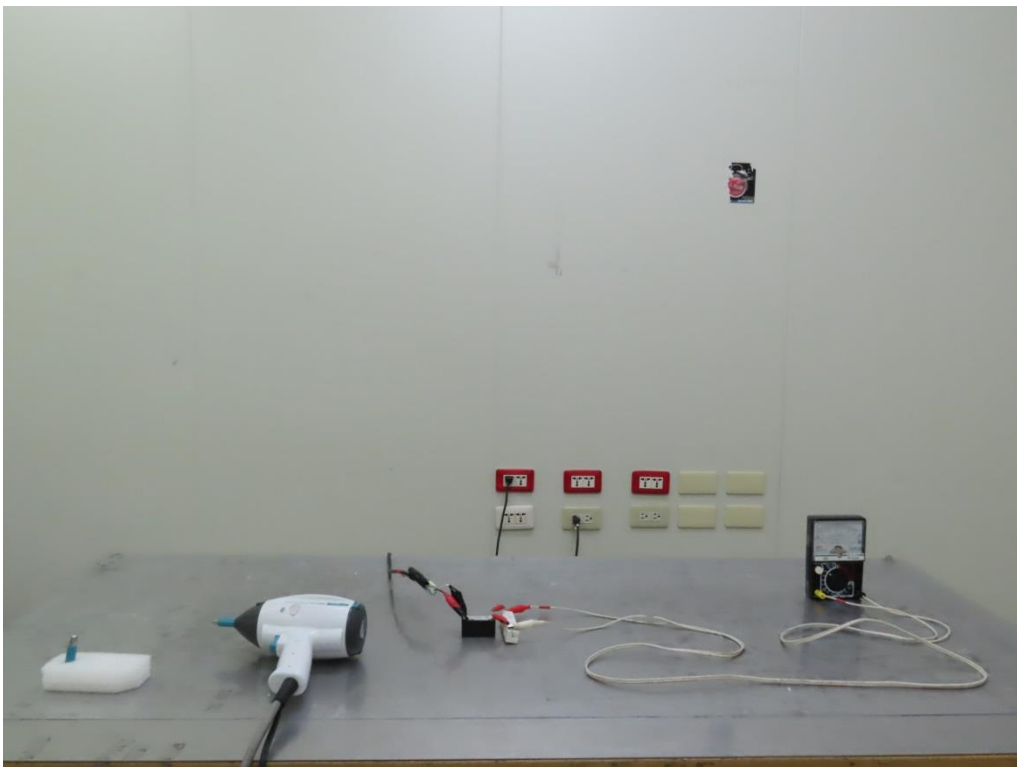
Rear View



EN55035
Mode 1

Front View

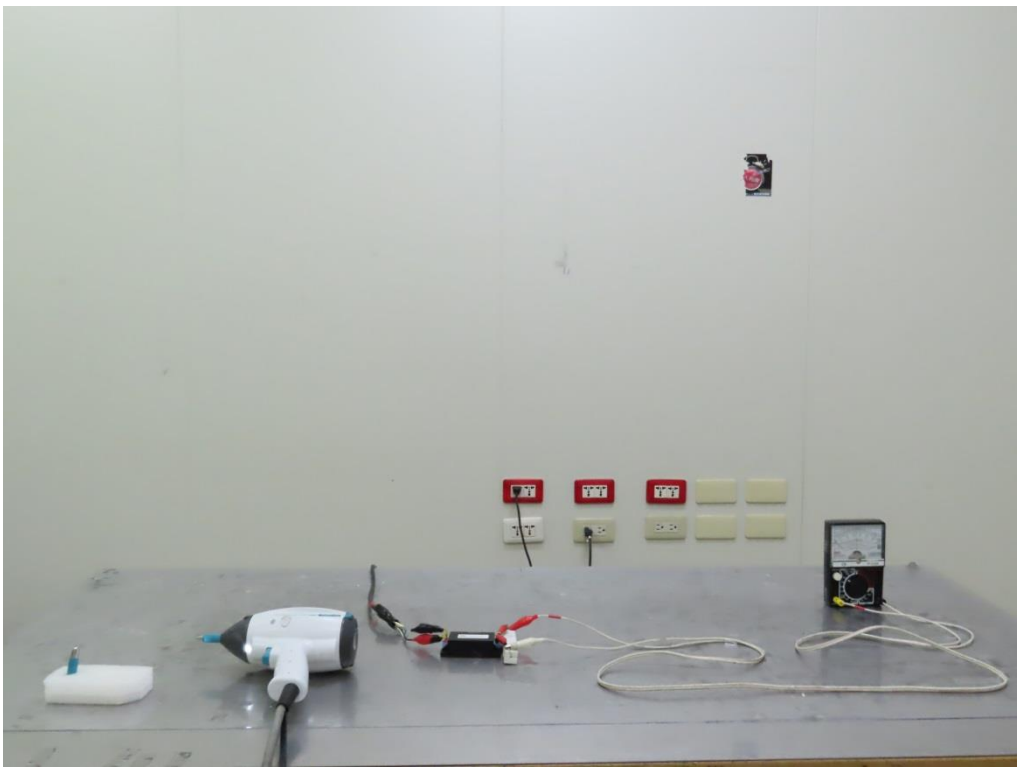
Rear View



EN55035
Mode 2

Front View

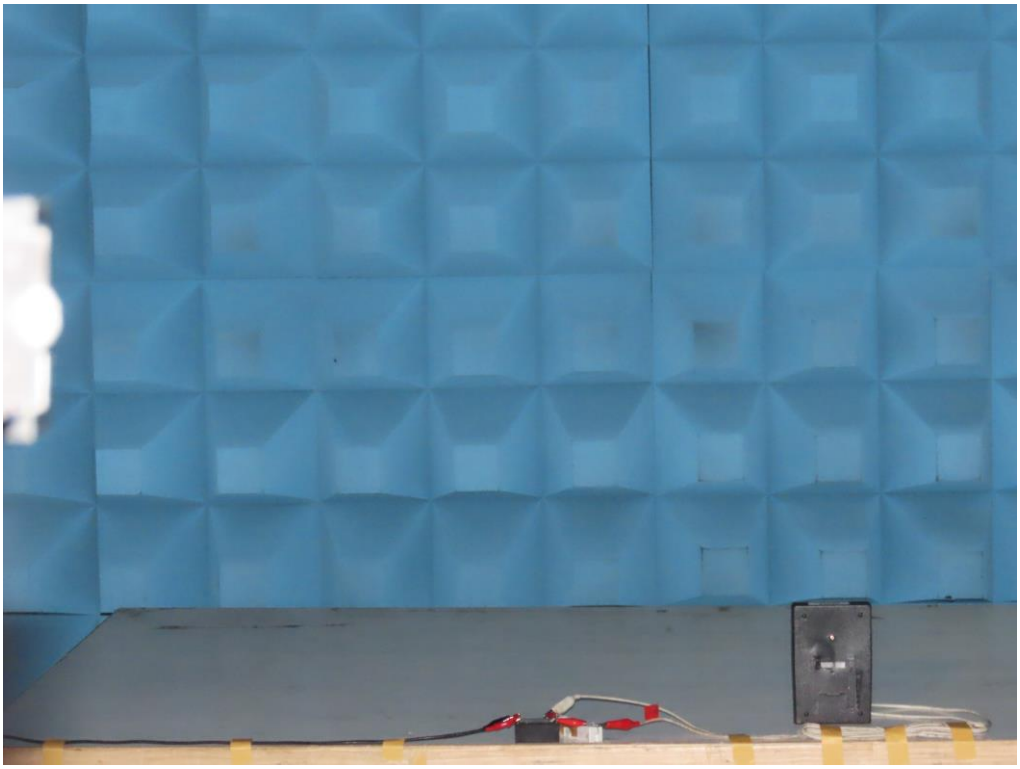
Rear View



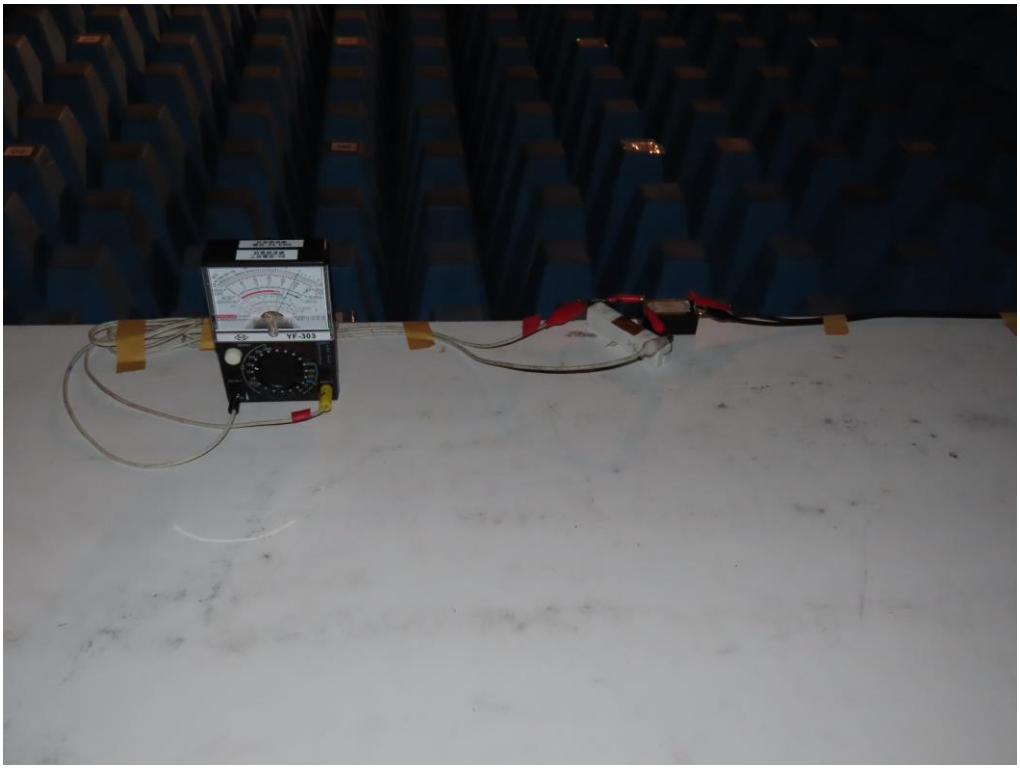
5. Photographs of RS Immunity Test Configuration

EN55024
Mode 1

Front View

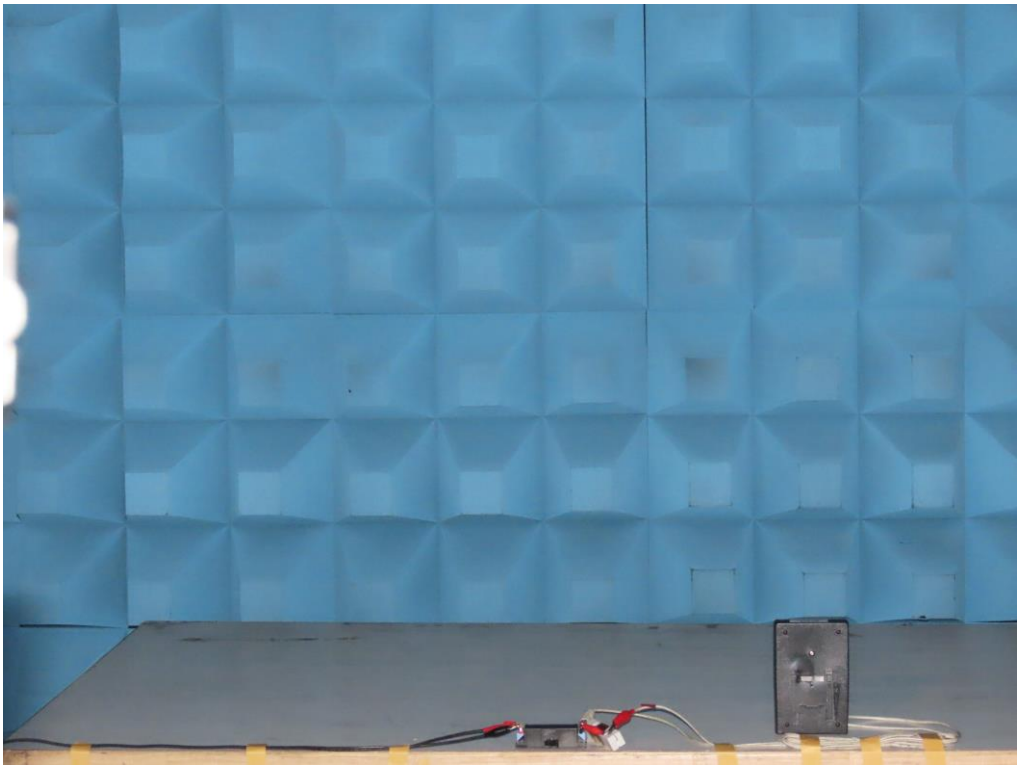


Rear View

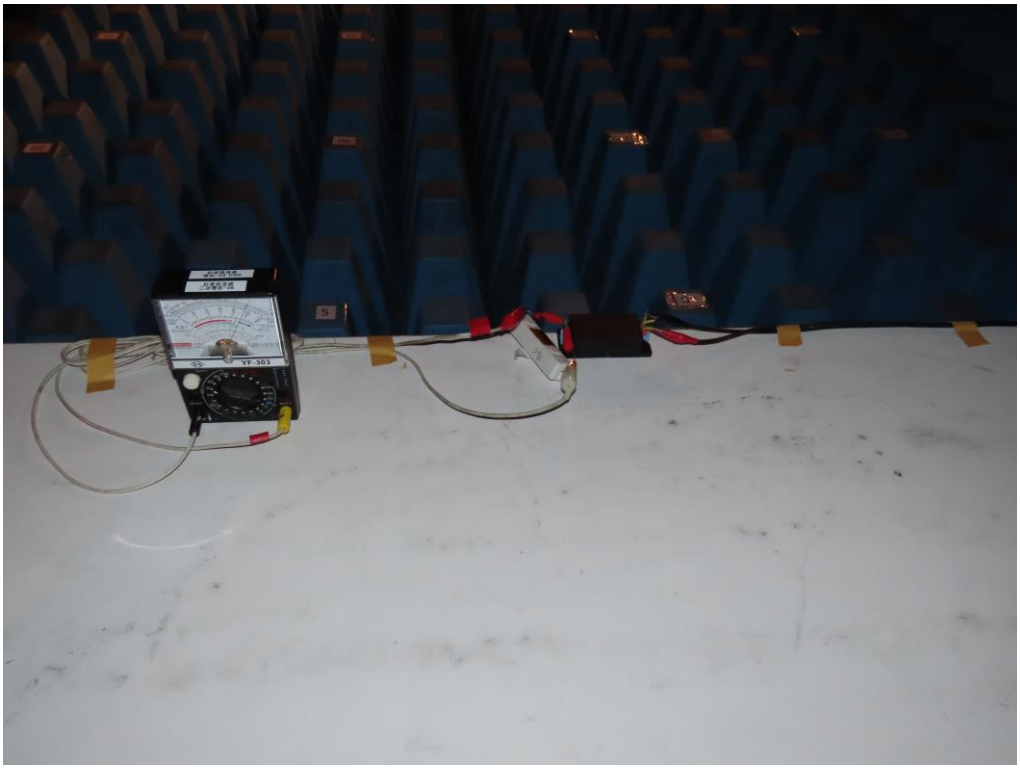


EN55024
Mode 2

Front View

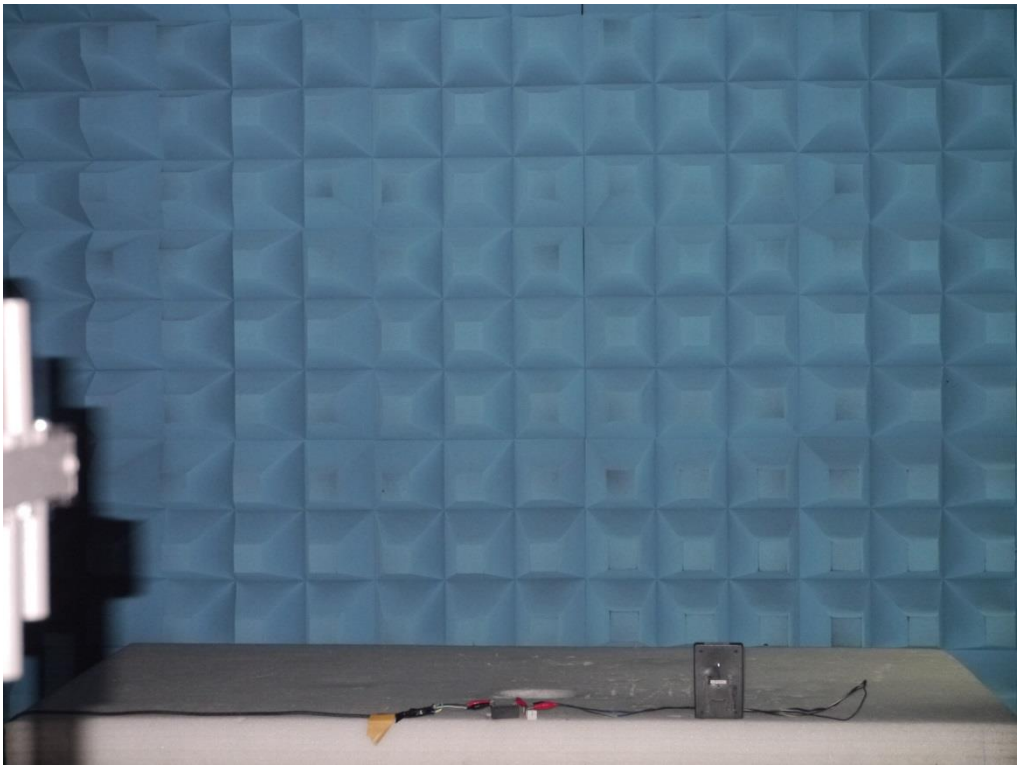


Rear View

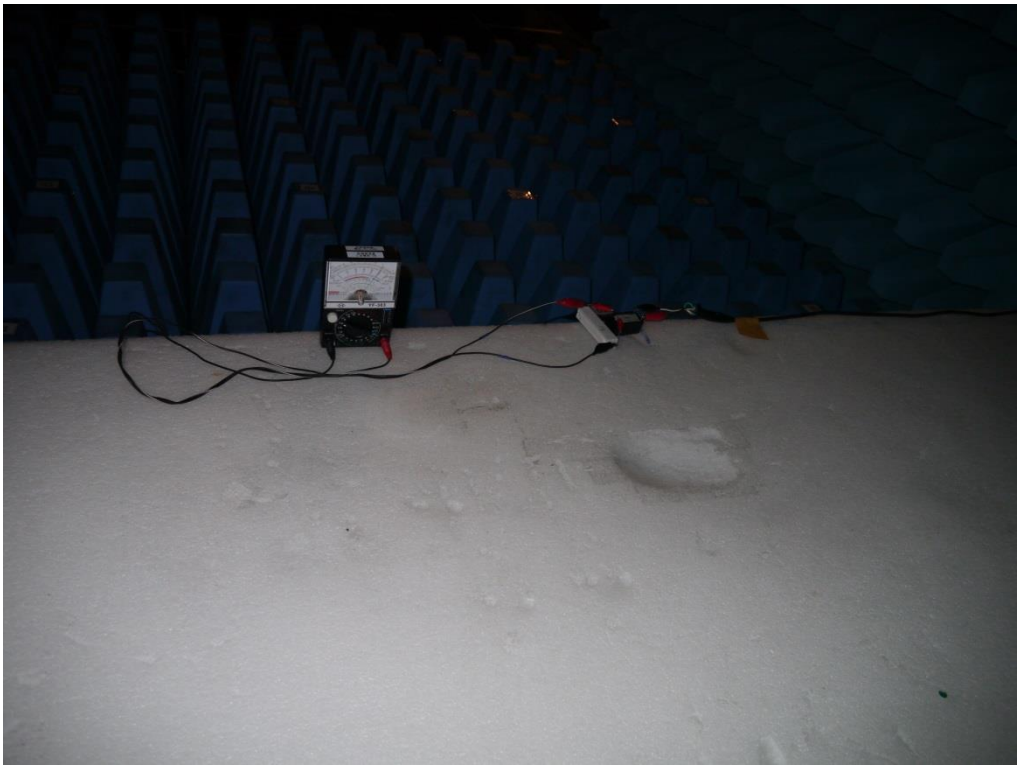


EN55035
Mode 1

Front View

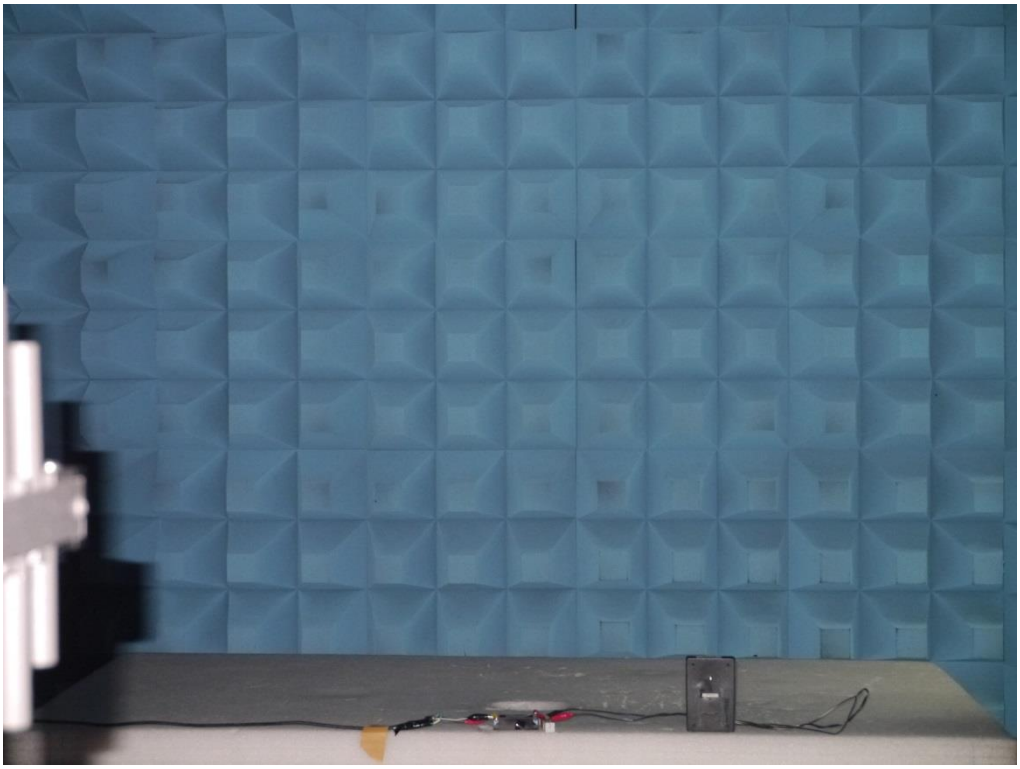


Rear View

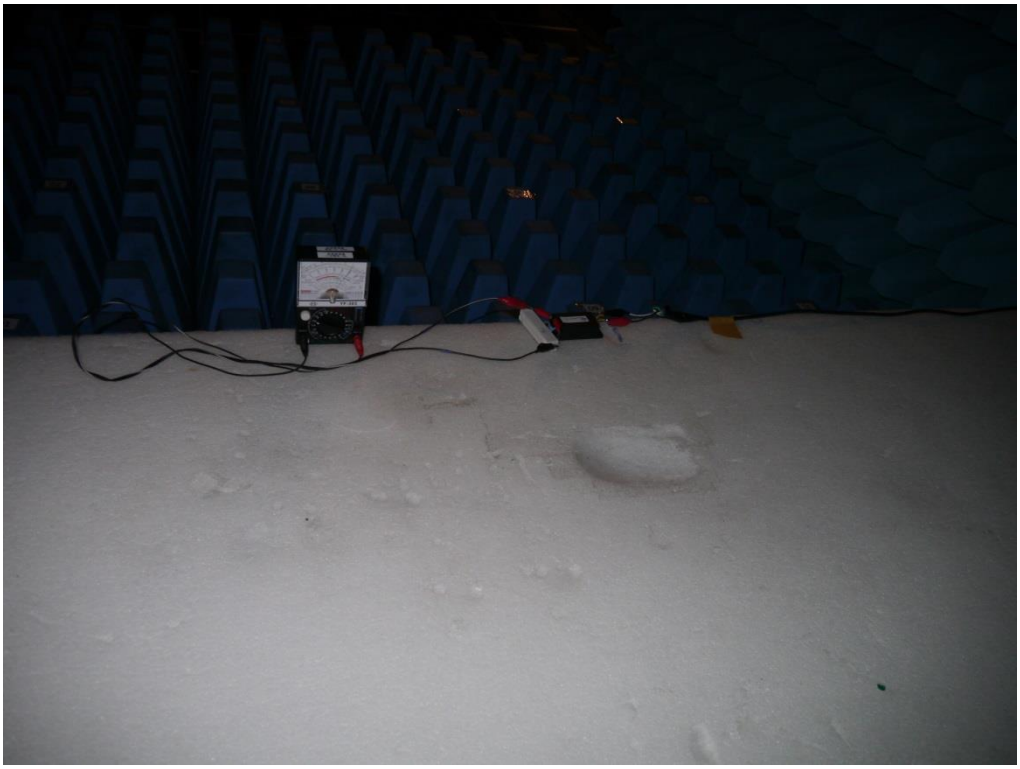


EN55035
Mode 2

Front View



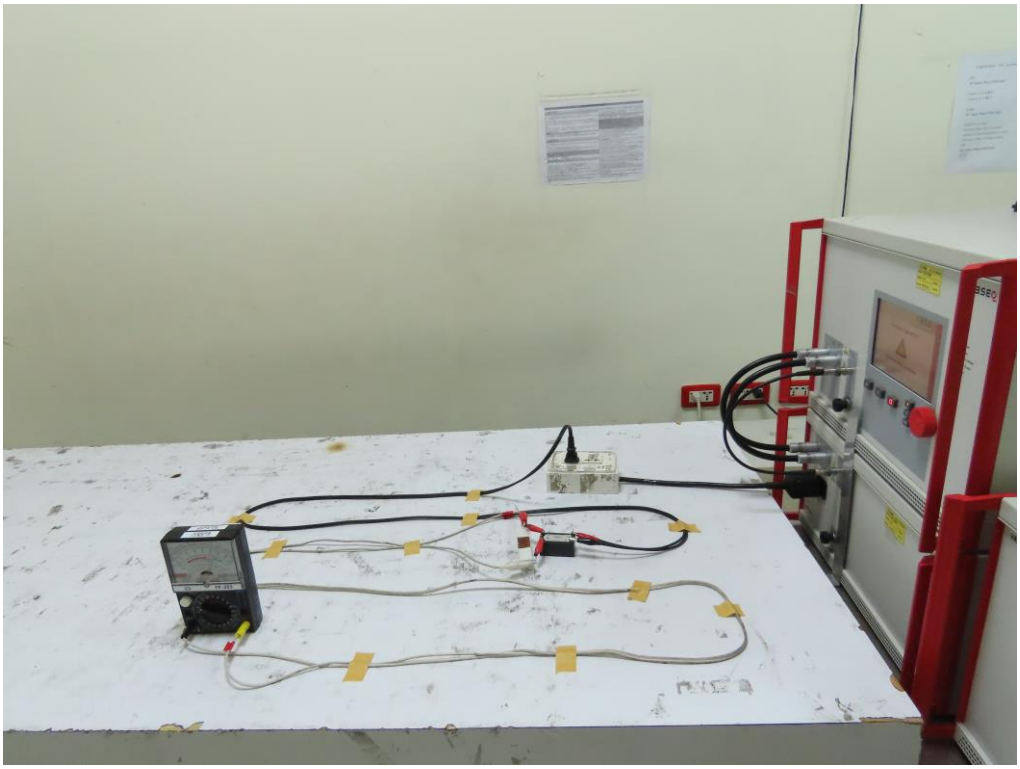
Rear View



6. Photographs of EFT Test Configuration

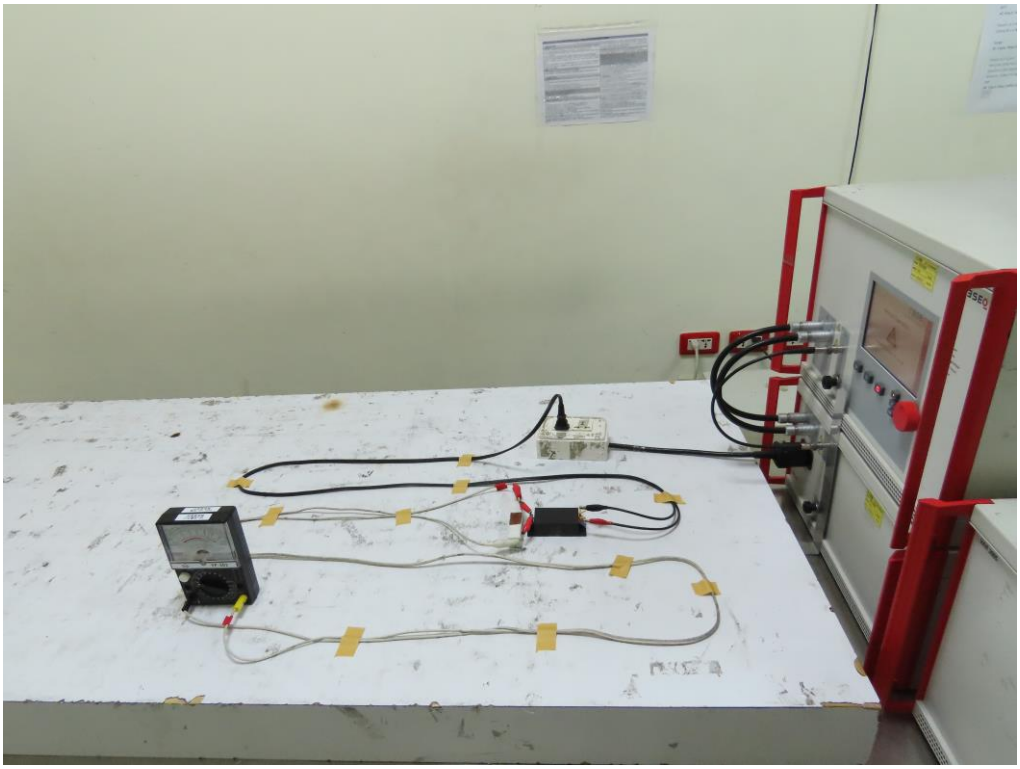
EN55024
Mode 1

Front View



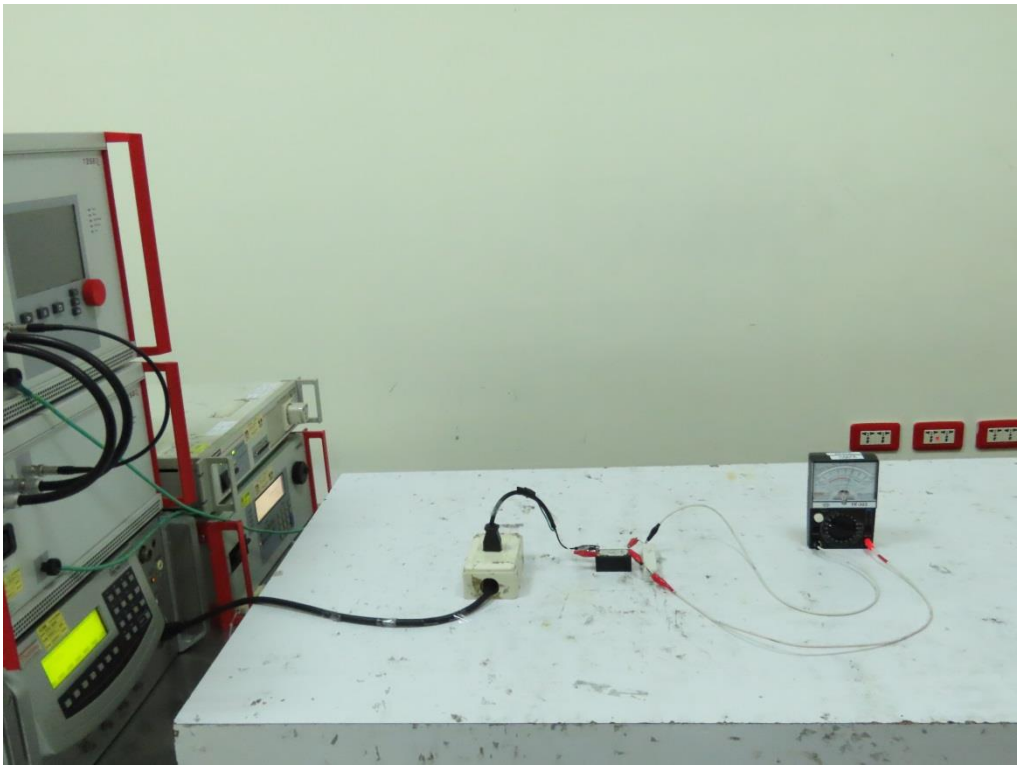
Mode 2

Front View



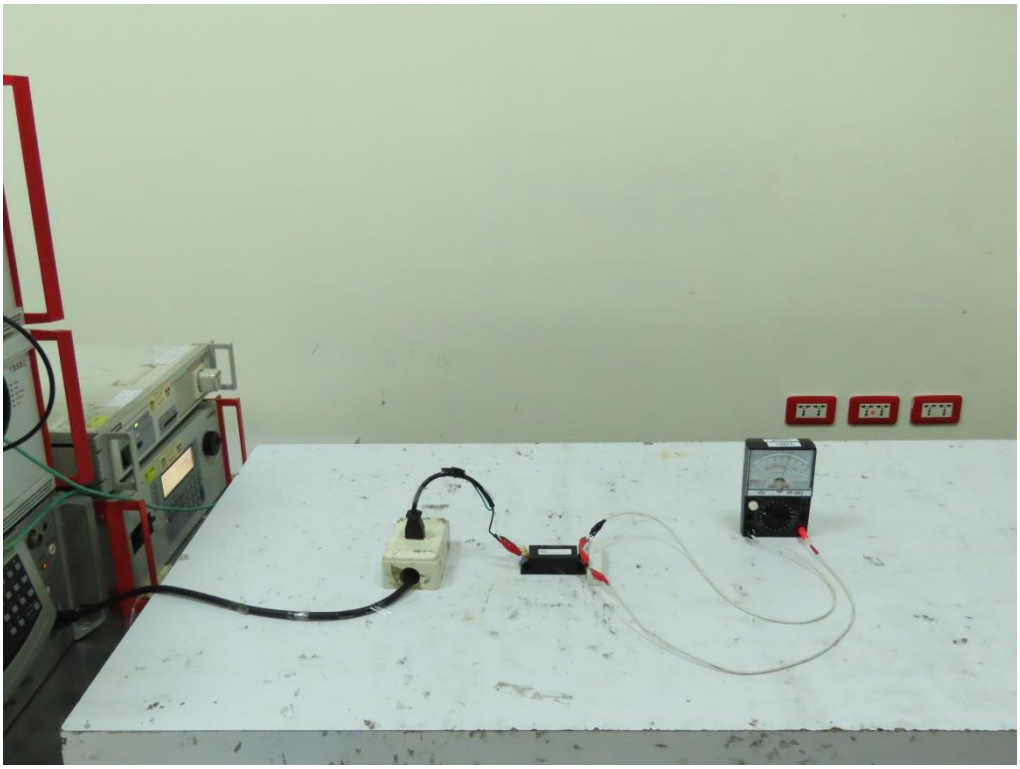
EN55035
Mode 1

Front View



Mode 2

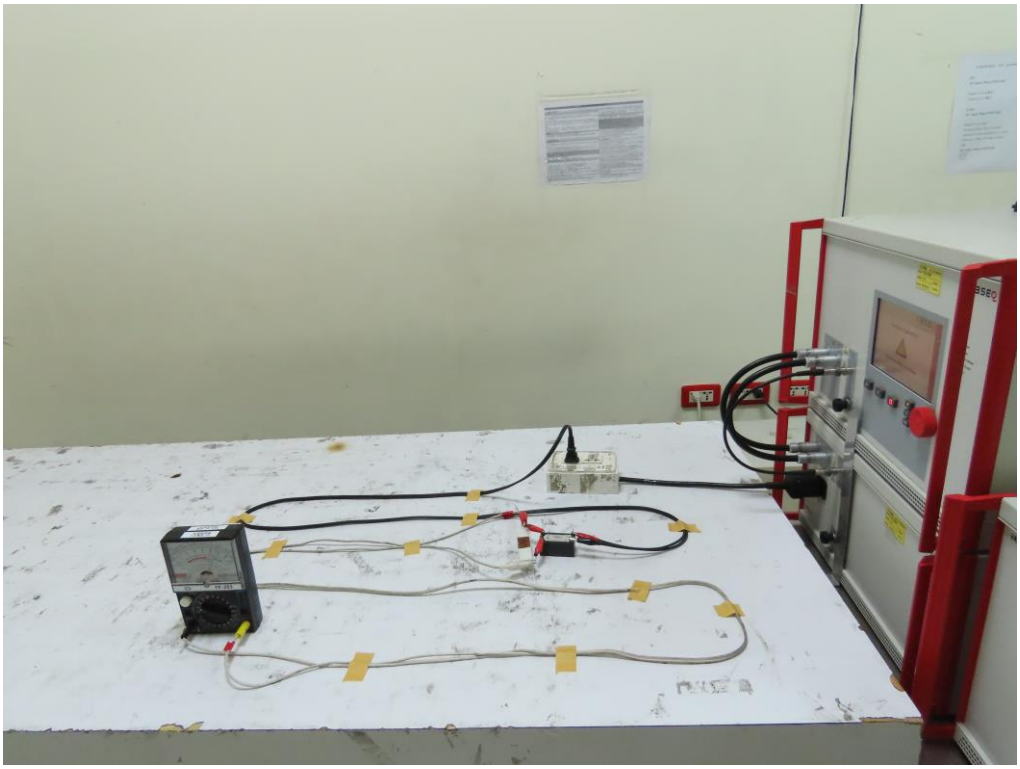
Front View



7. Photographs of Surge Test Configuration

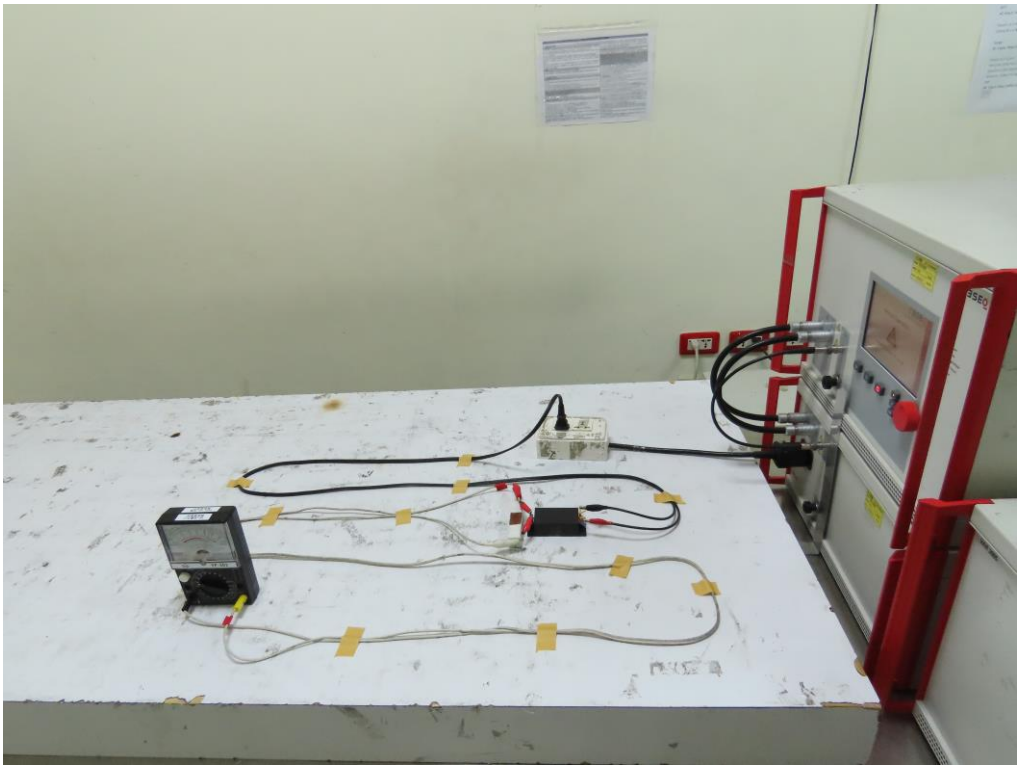
EN55024
Mode 1

Front View



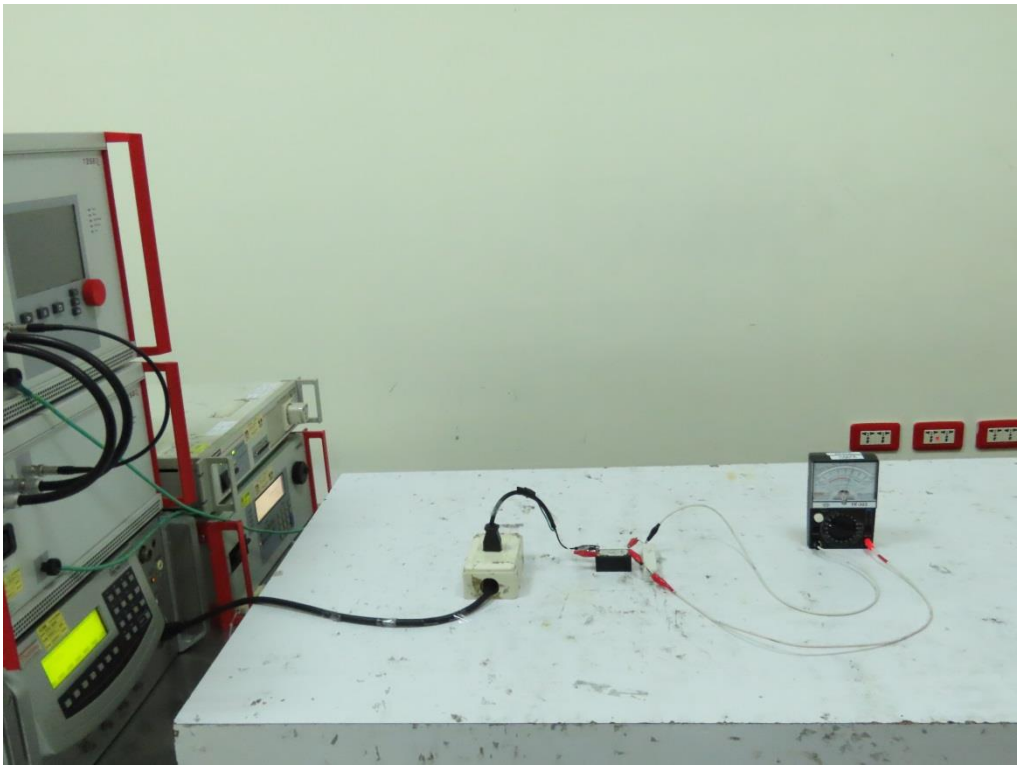
Mode 2

Front View



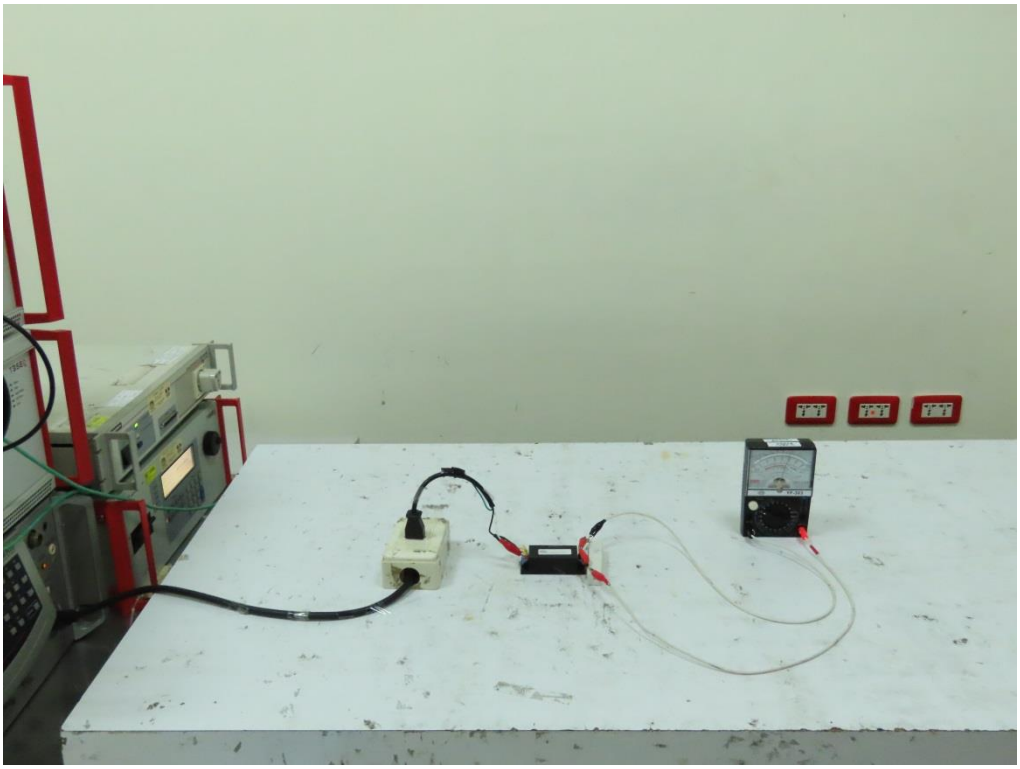
EN55035
Mode 1

Front View



Mode 2

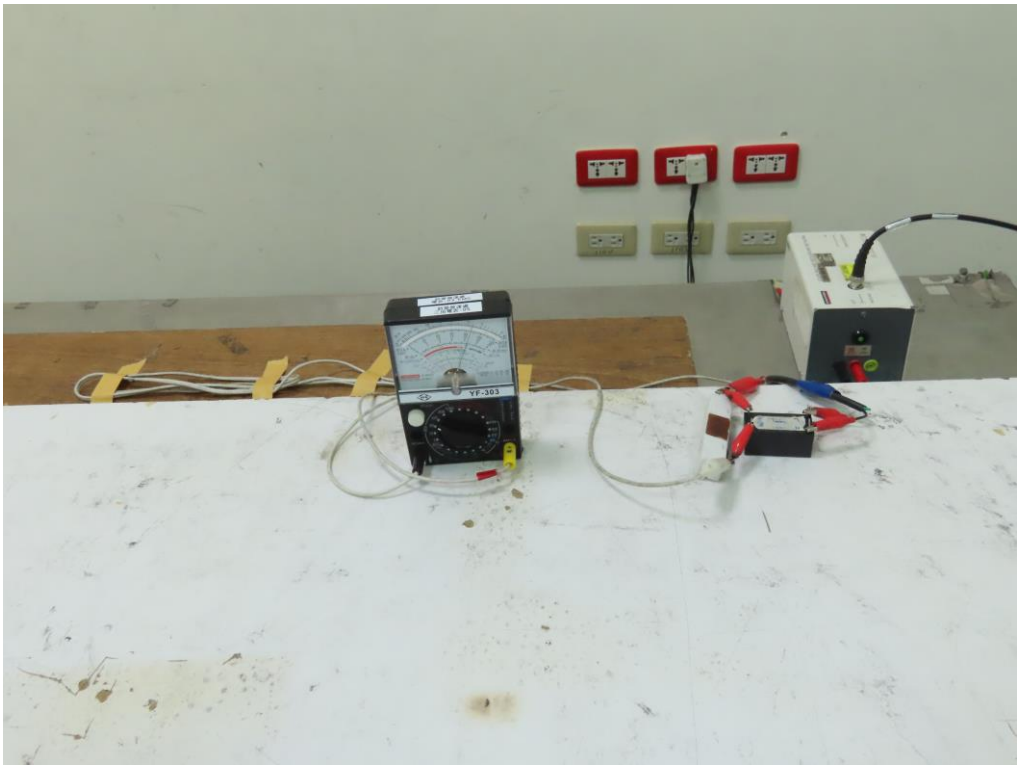
Front View



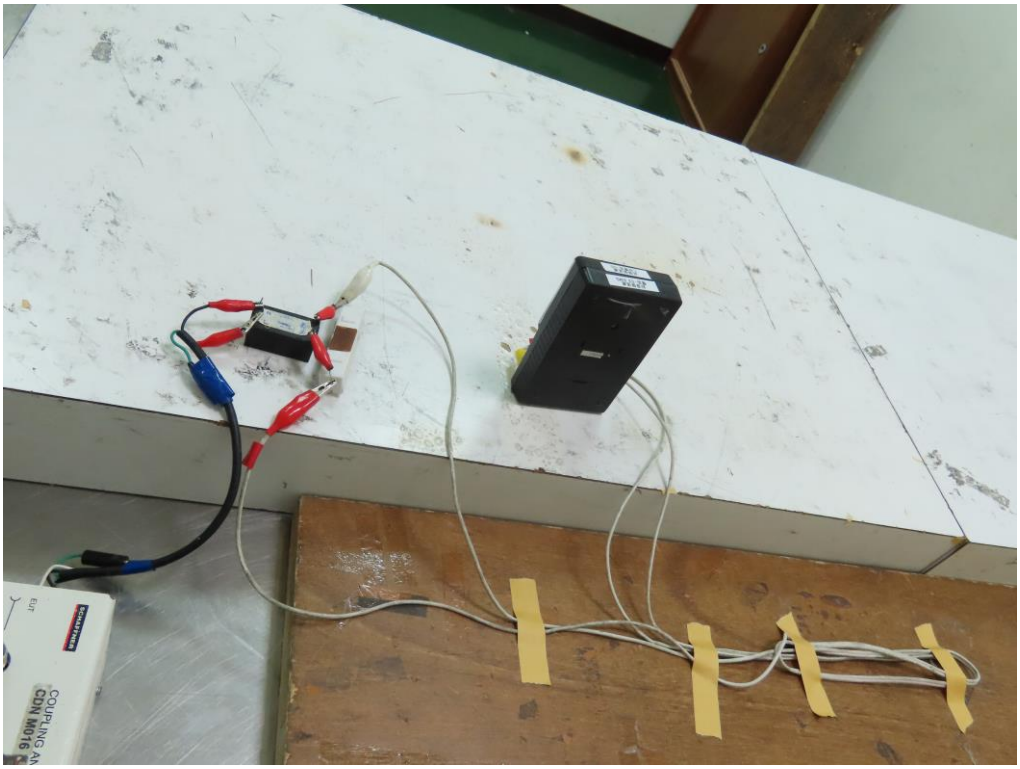
8. Photographs of CS Immunity Test Configuration

EN55024
Mode 1

Front View

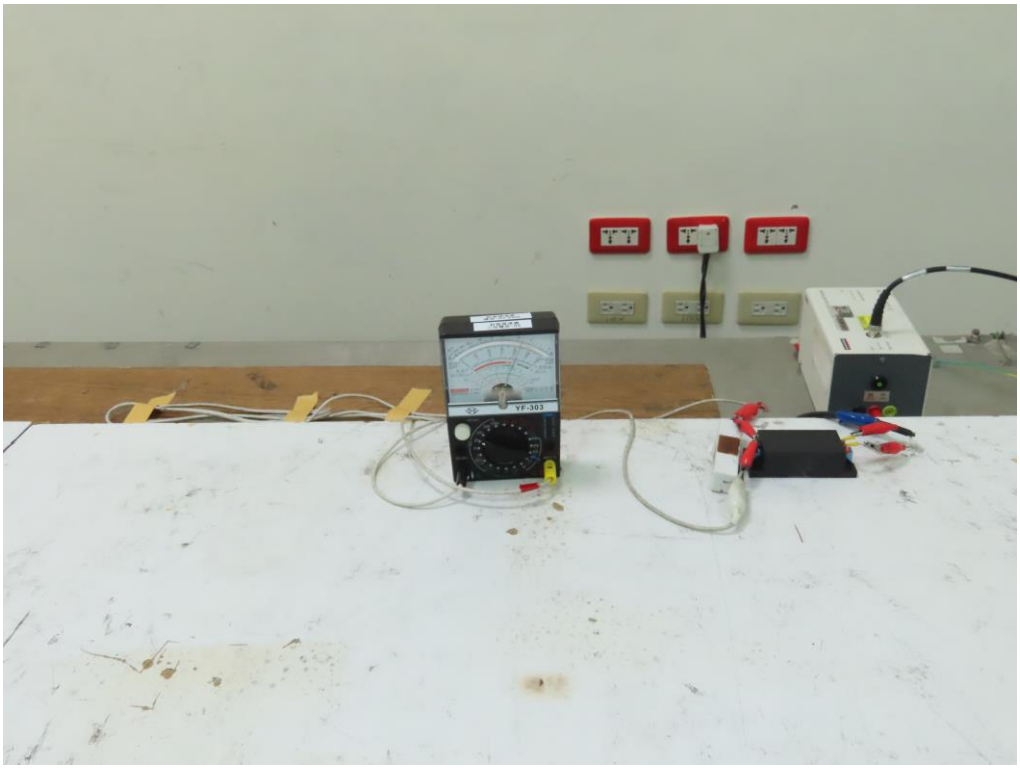


Rear View

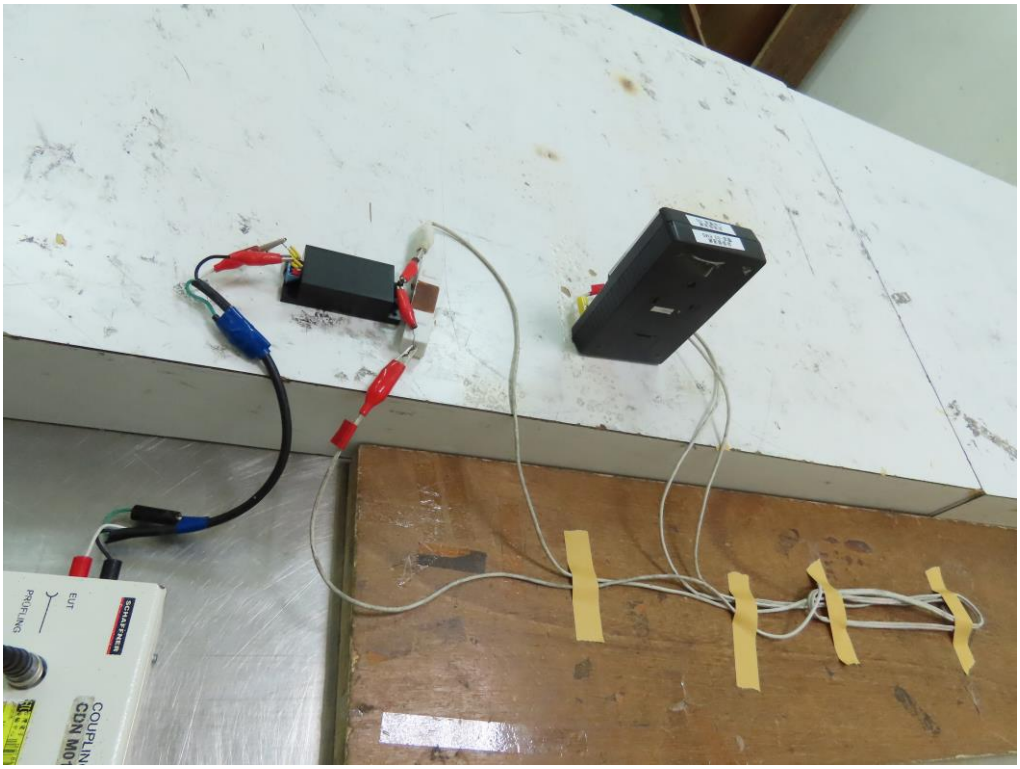


EN55024
Mode 2

Front View

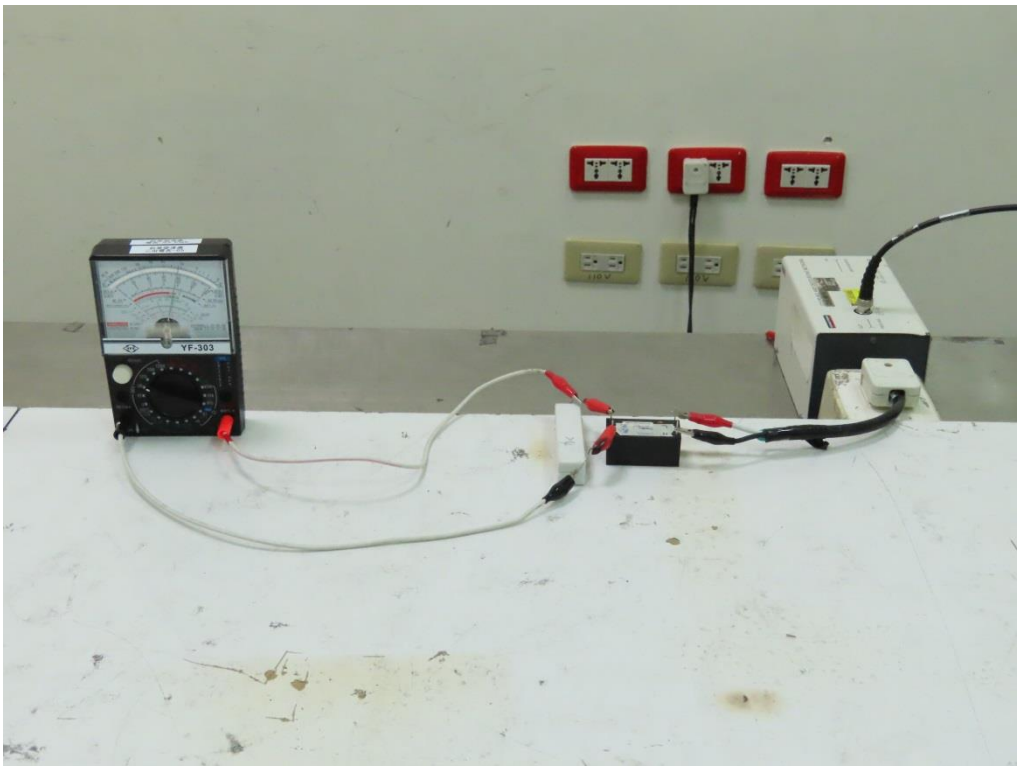


Rear View

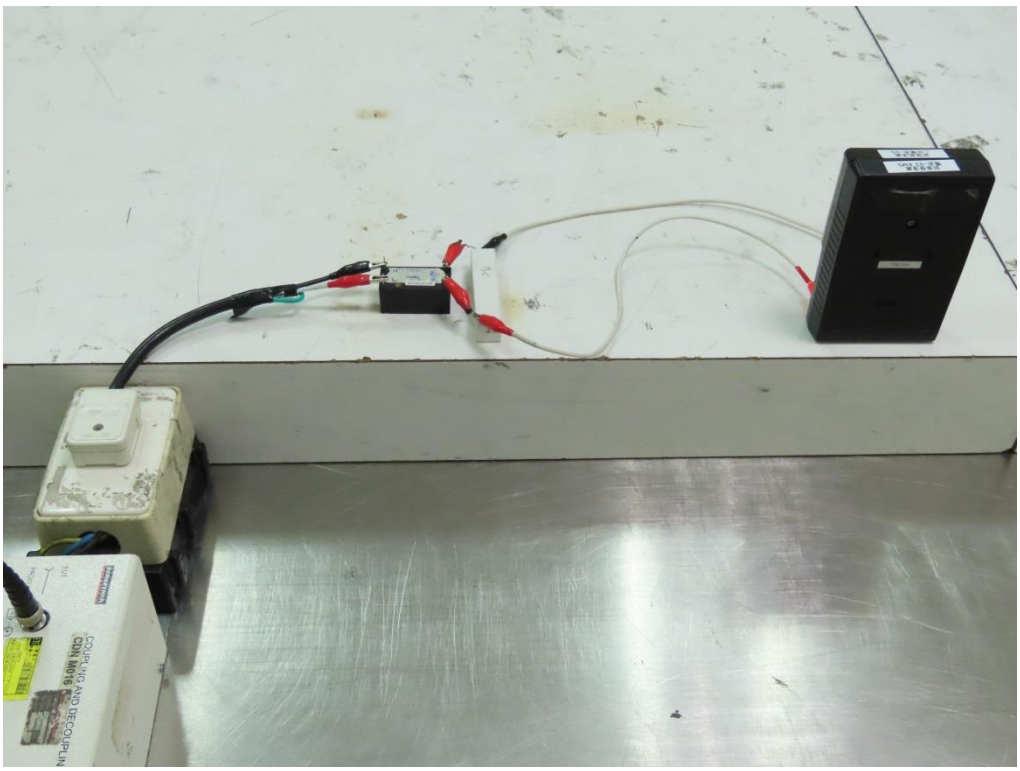


EN55035
Mode 1

Front View

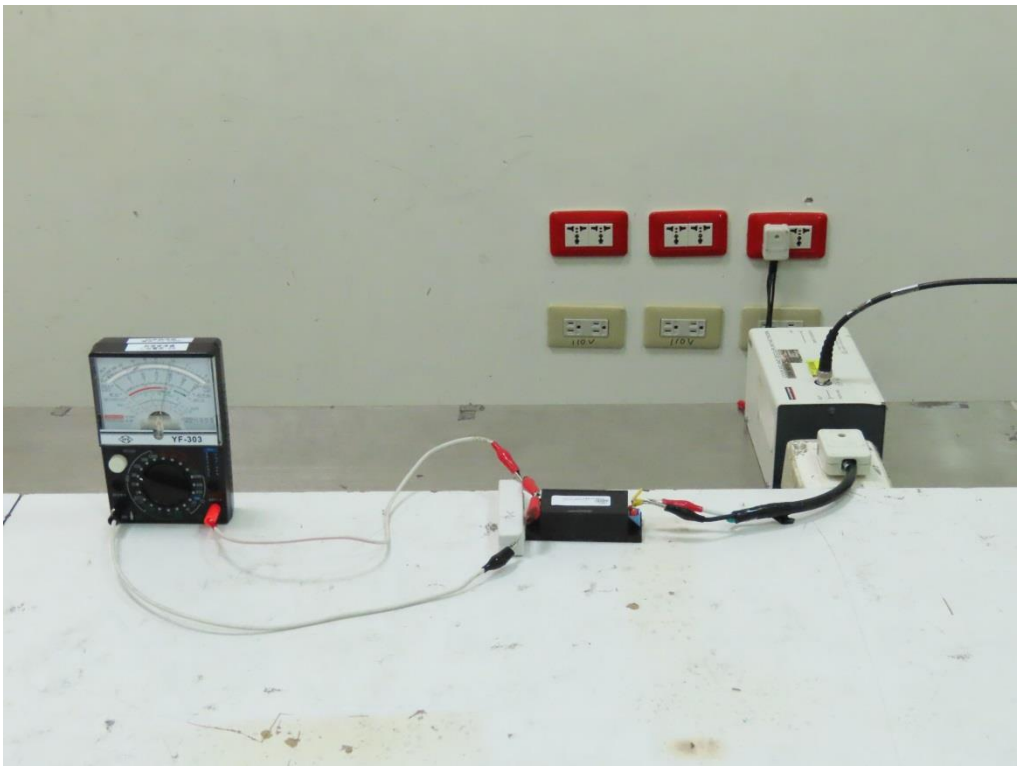


Rear View

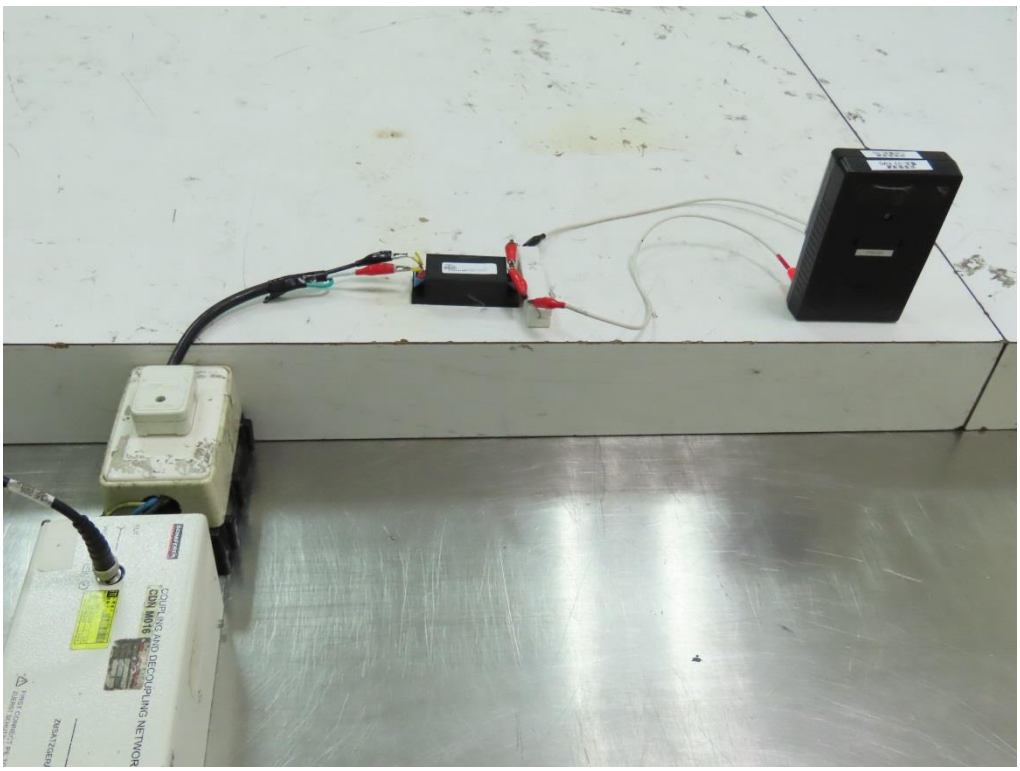


EN55035
Mode 2

Front View



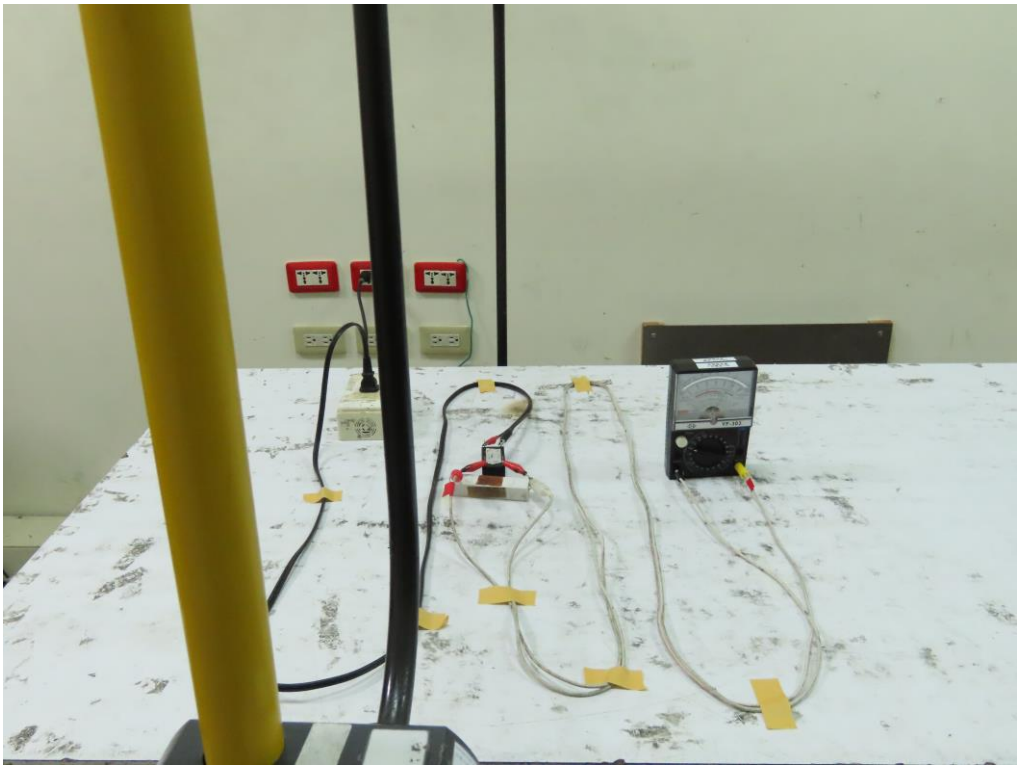
Rear View



9. Power Frequency Magnetic Field immunity Measurement (PFMF)

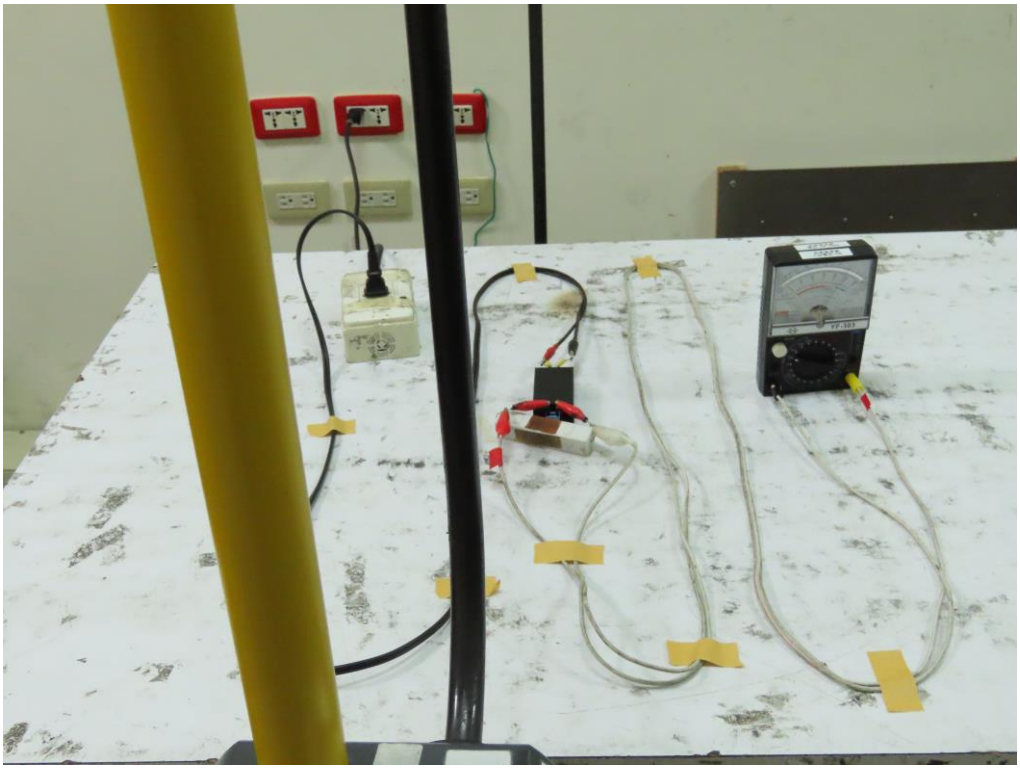
EN55024
Mode 1

Front View



Mode 2

Front View

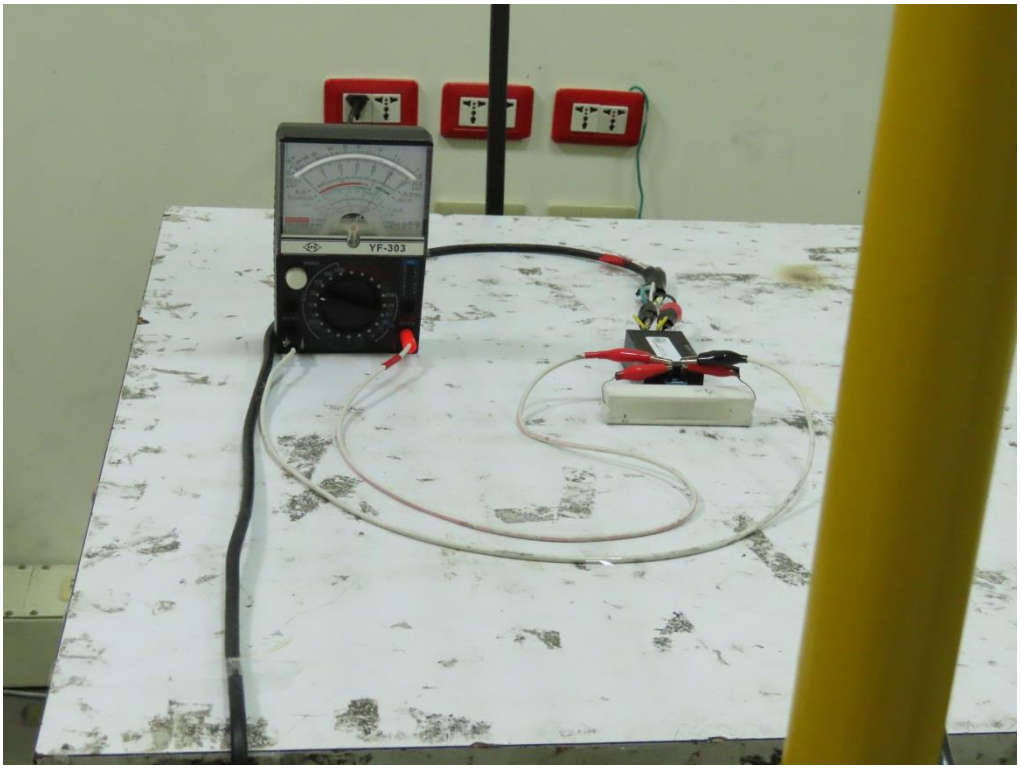


EN55035
Mode 1

Front View

Mode 2

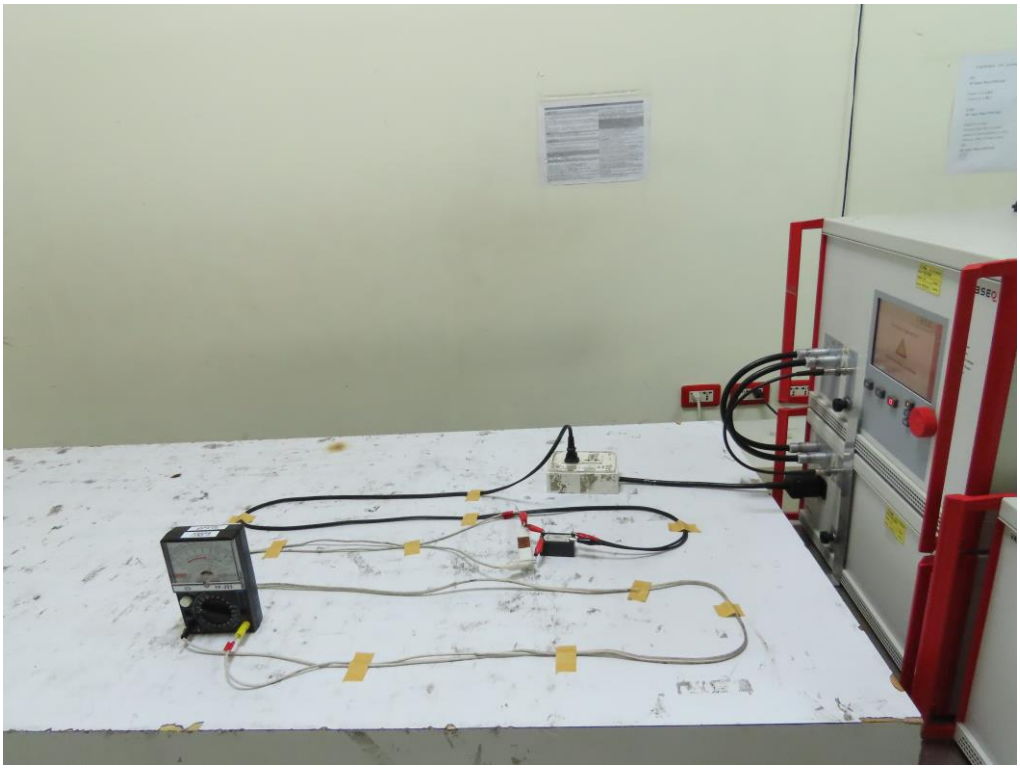
Front View



10. Photographs of Dip Test Configuration

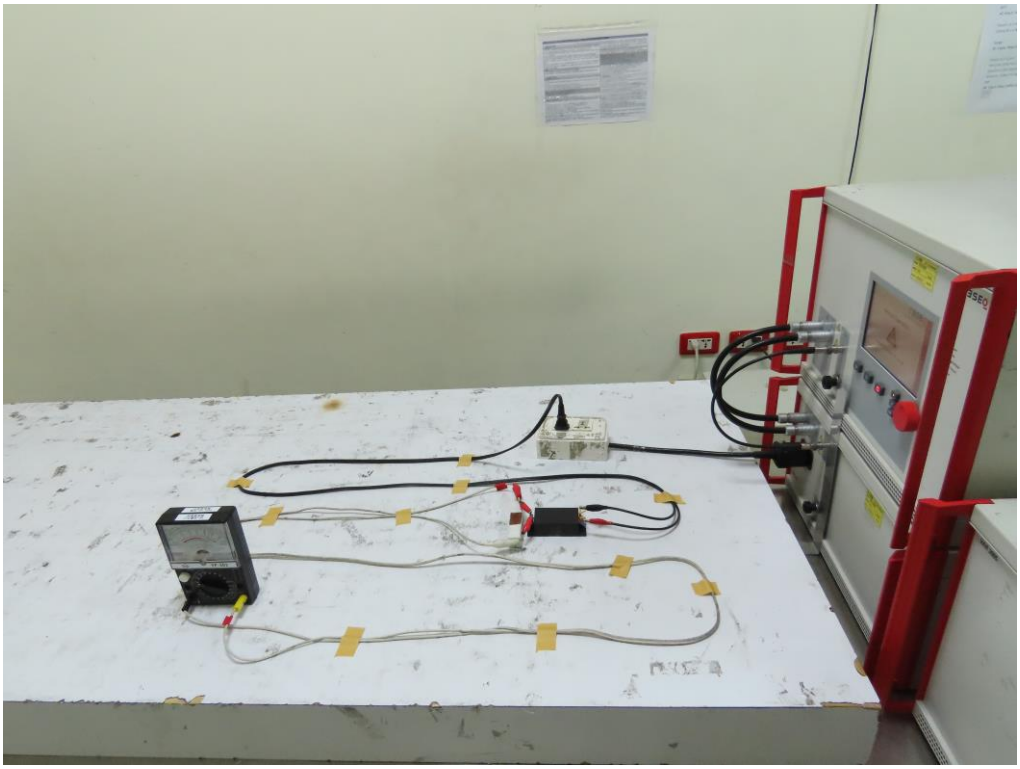
EN55024
Mode 1

Front View



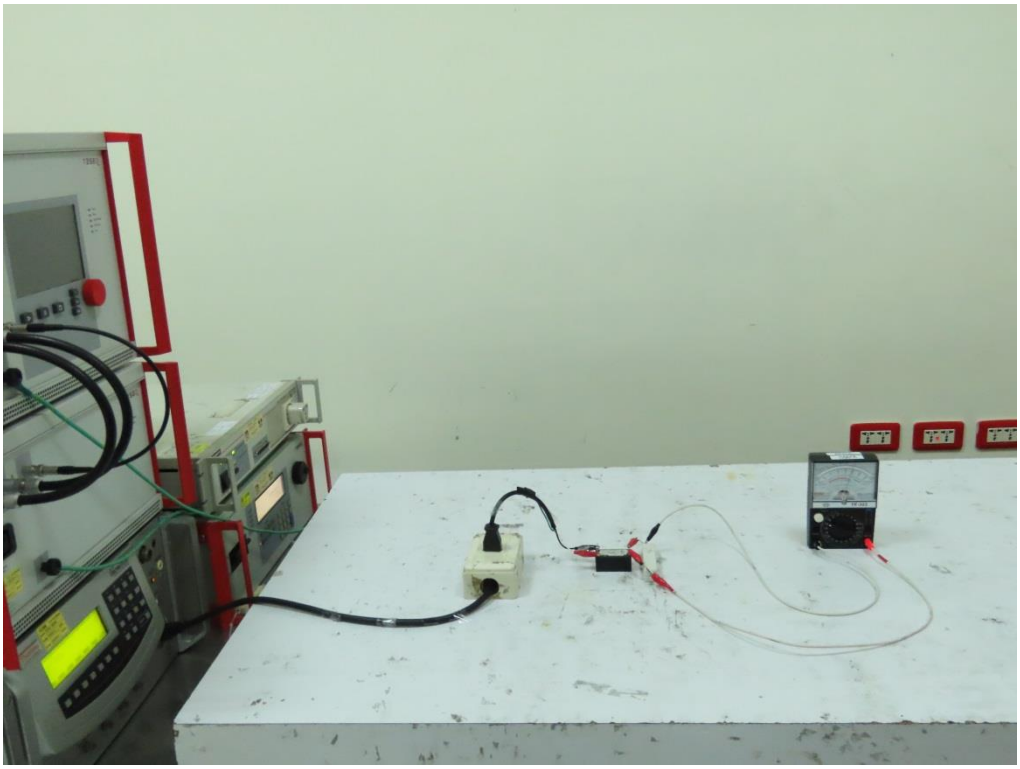
Mode 2

Front View



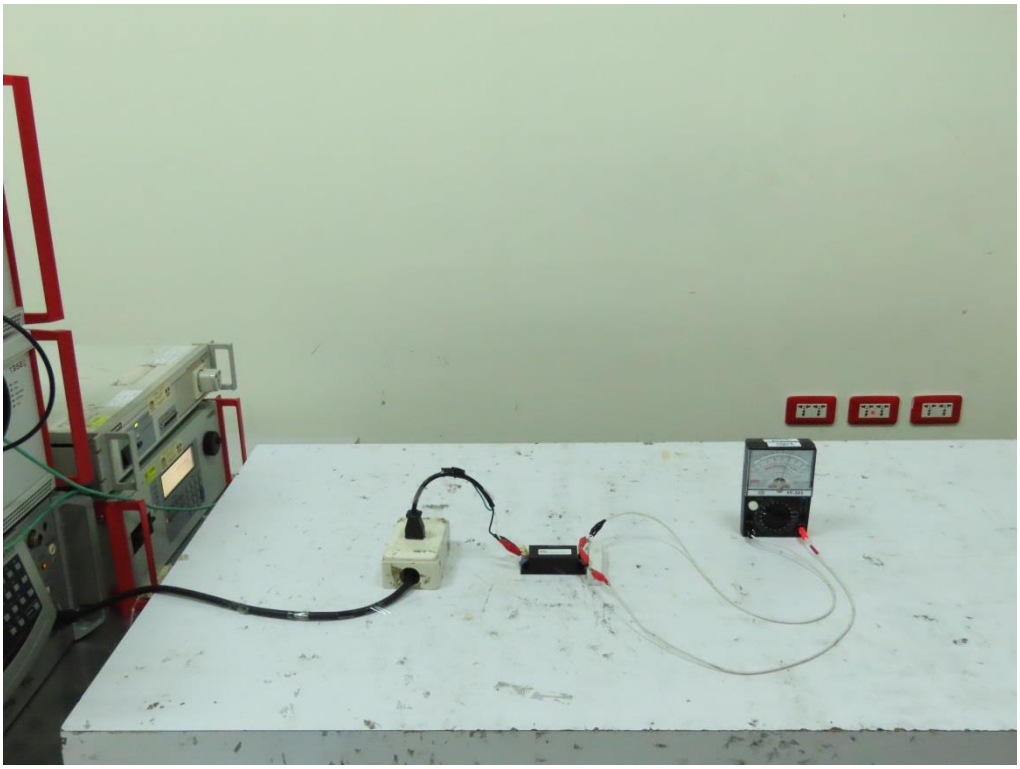
EN55035
Mode 1

Front View



Mode 2

Front View



———THE END———

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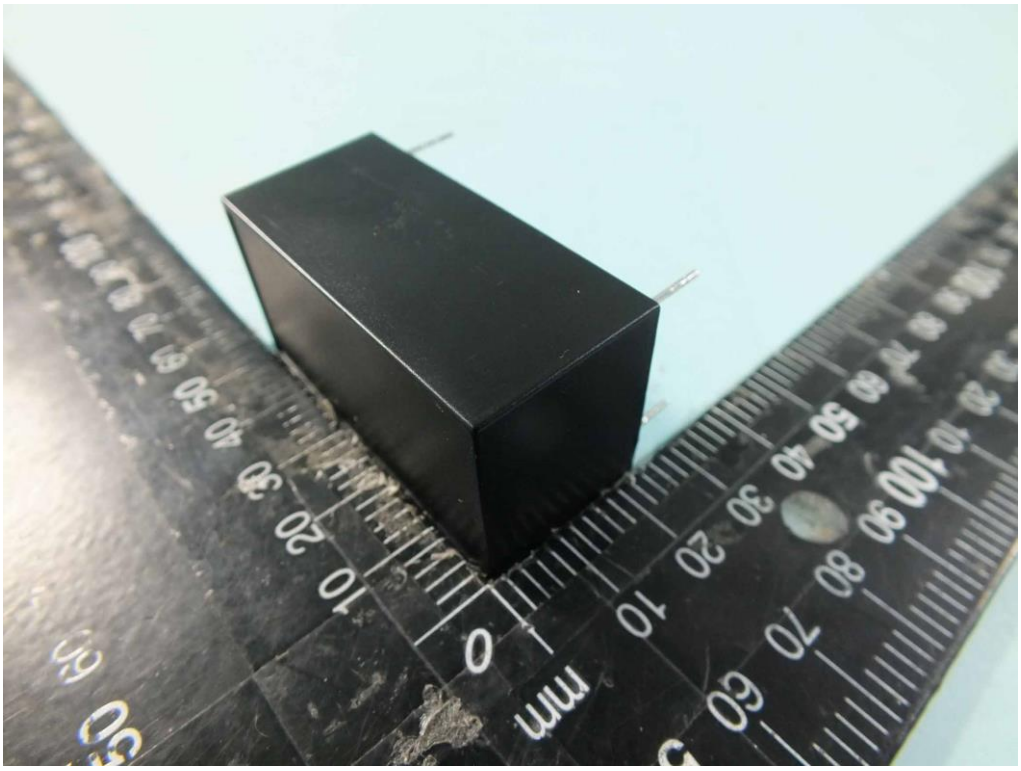

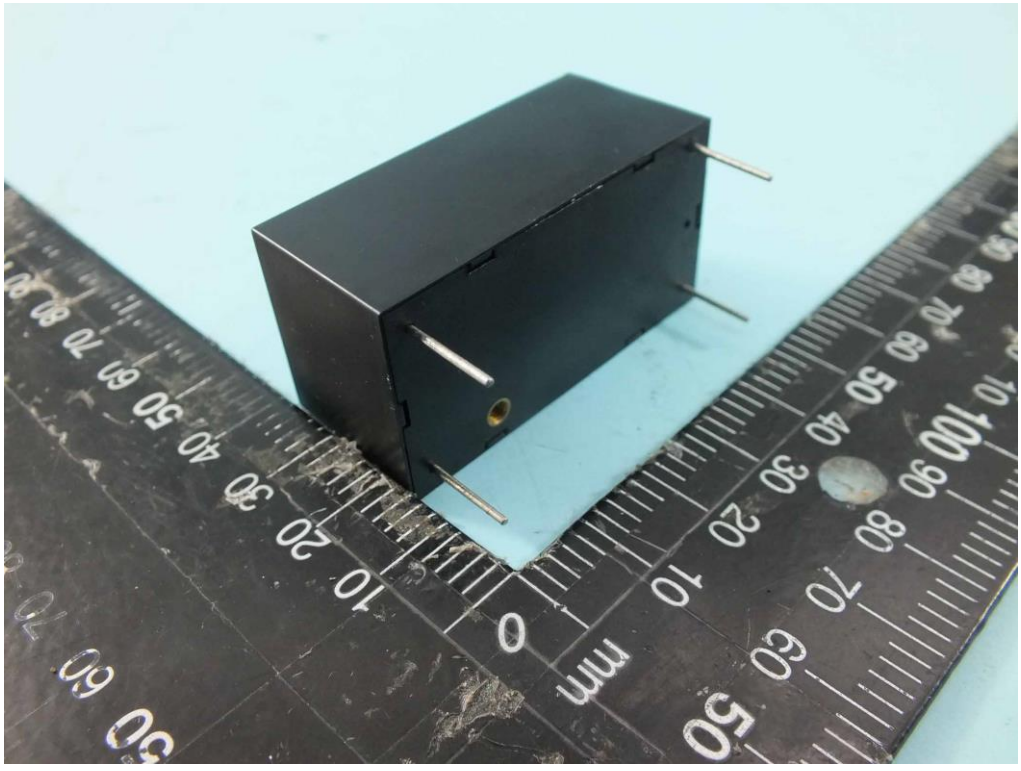

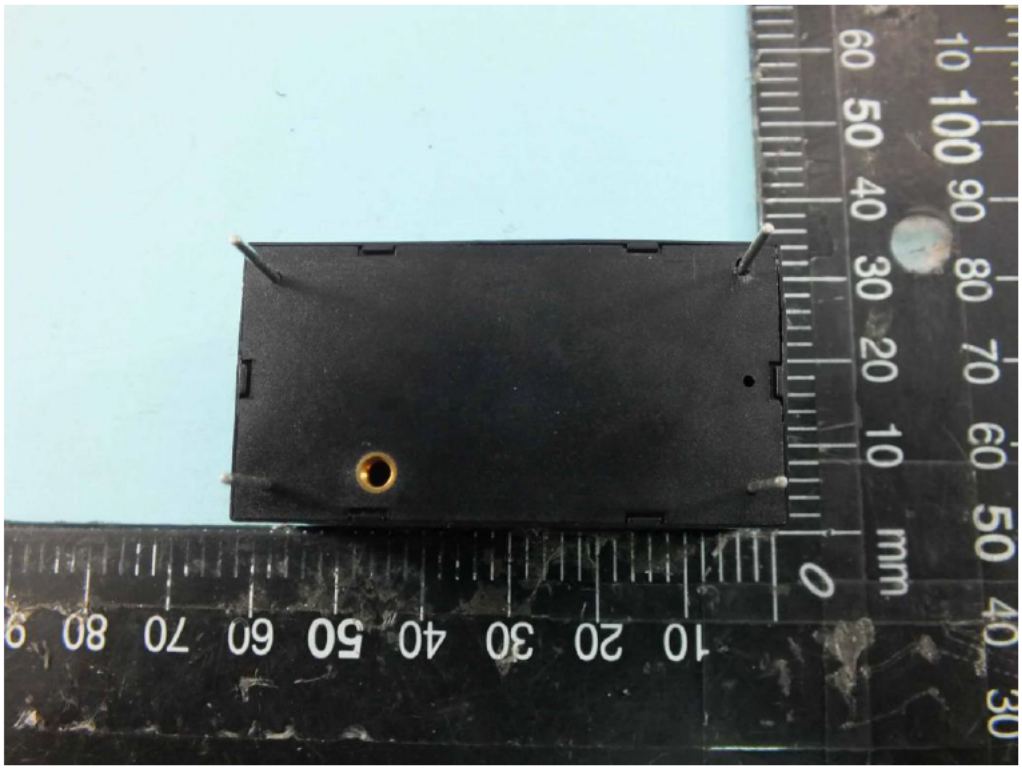

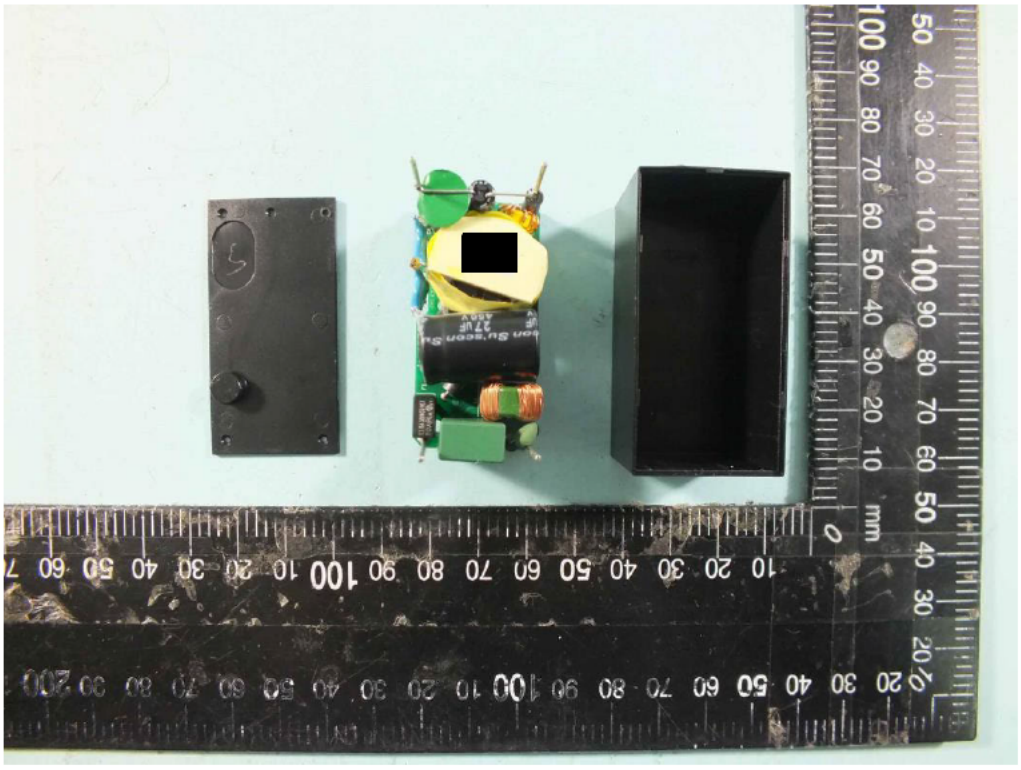

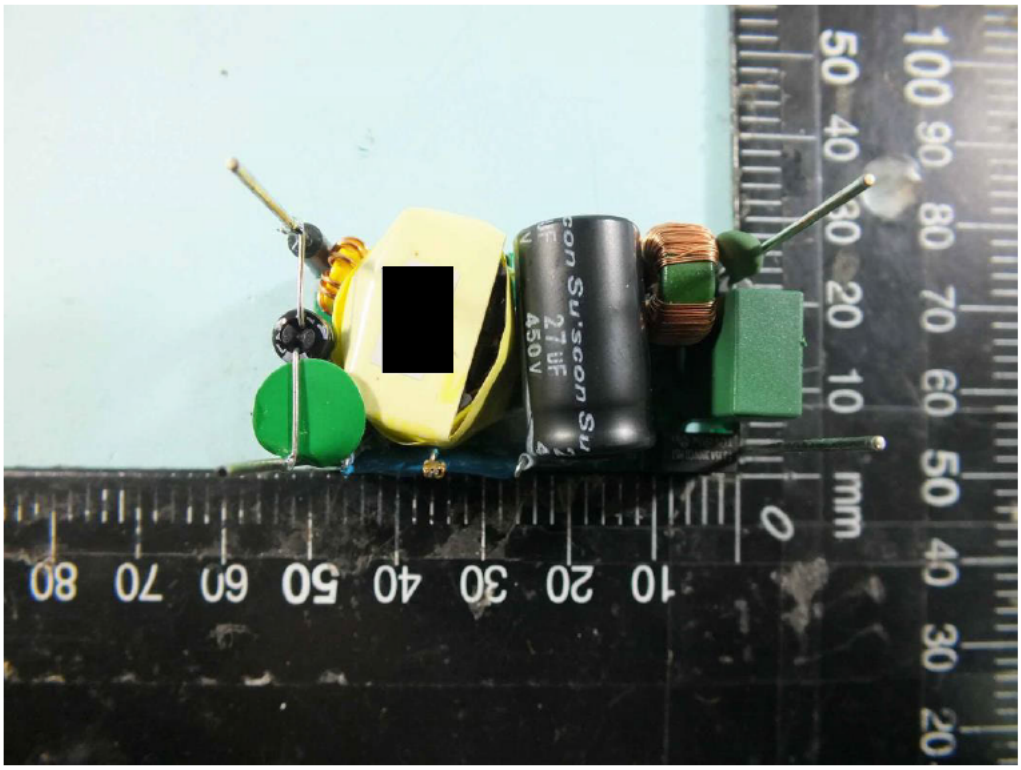
2.1 uF
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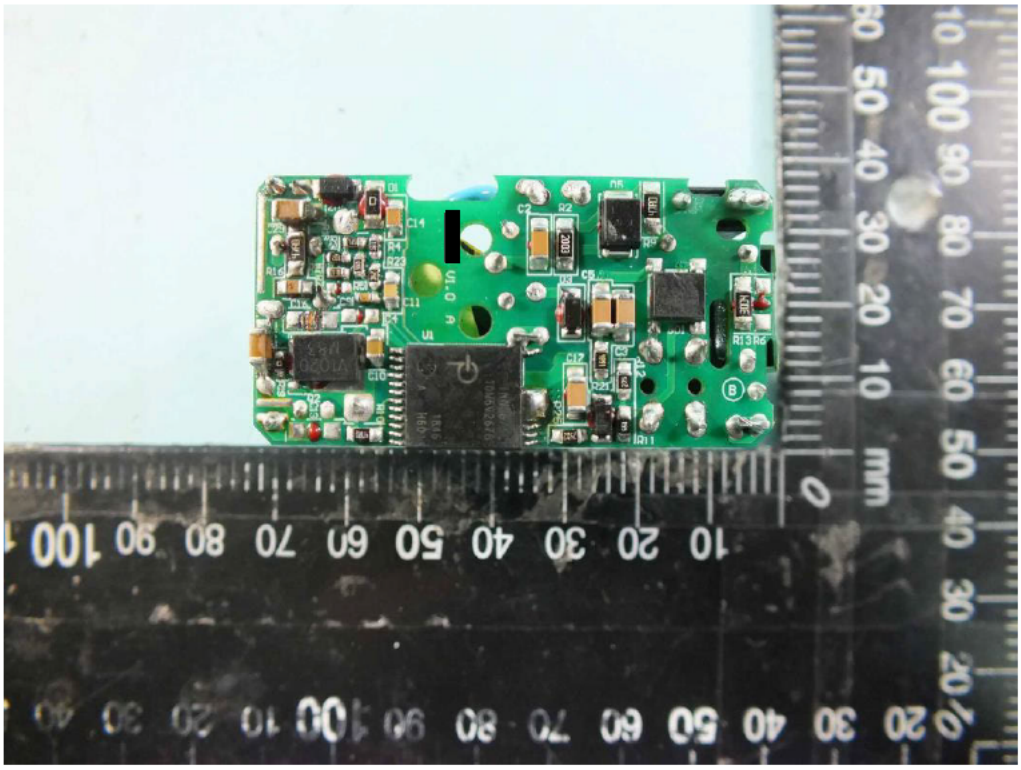

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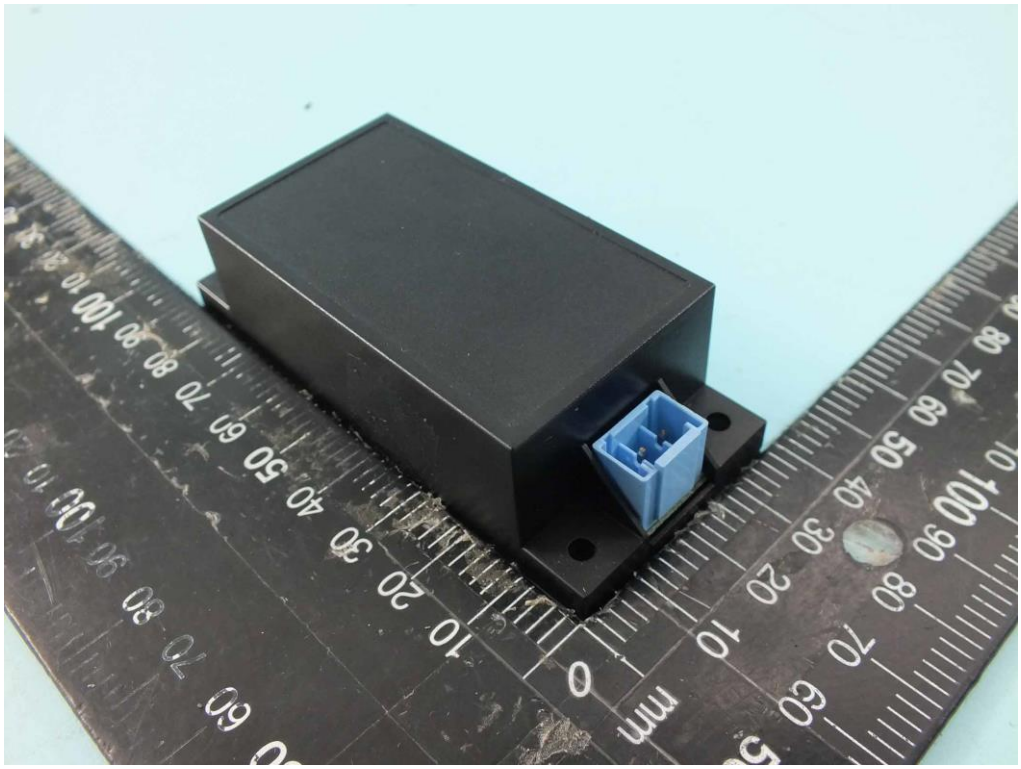

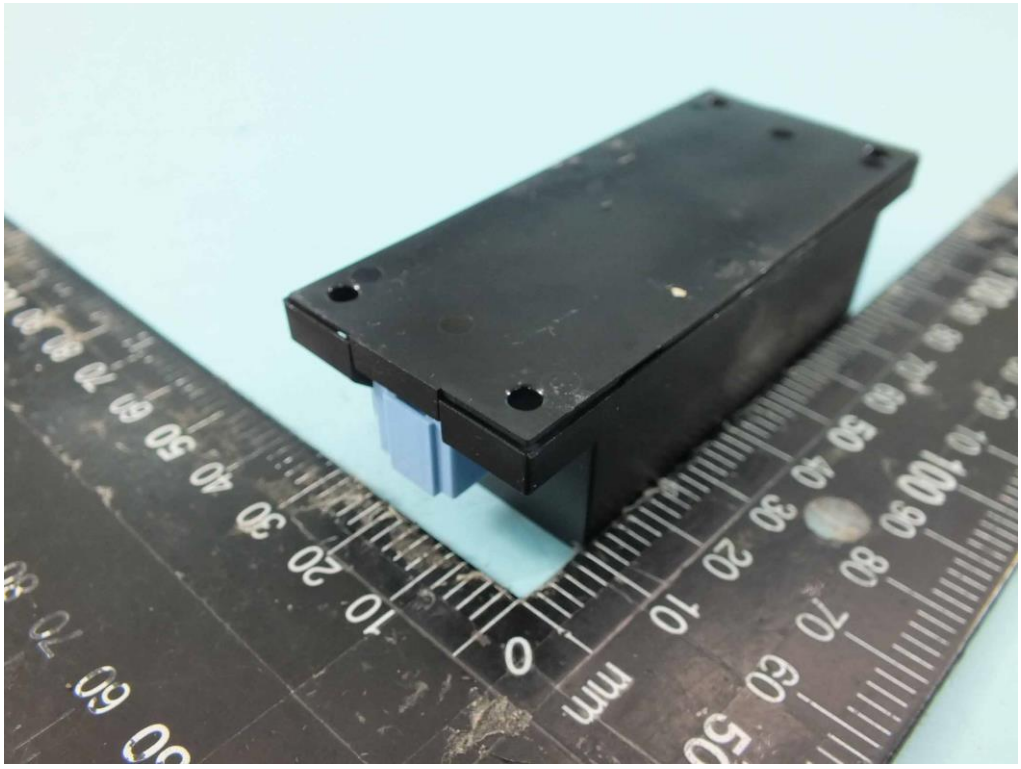

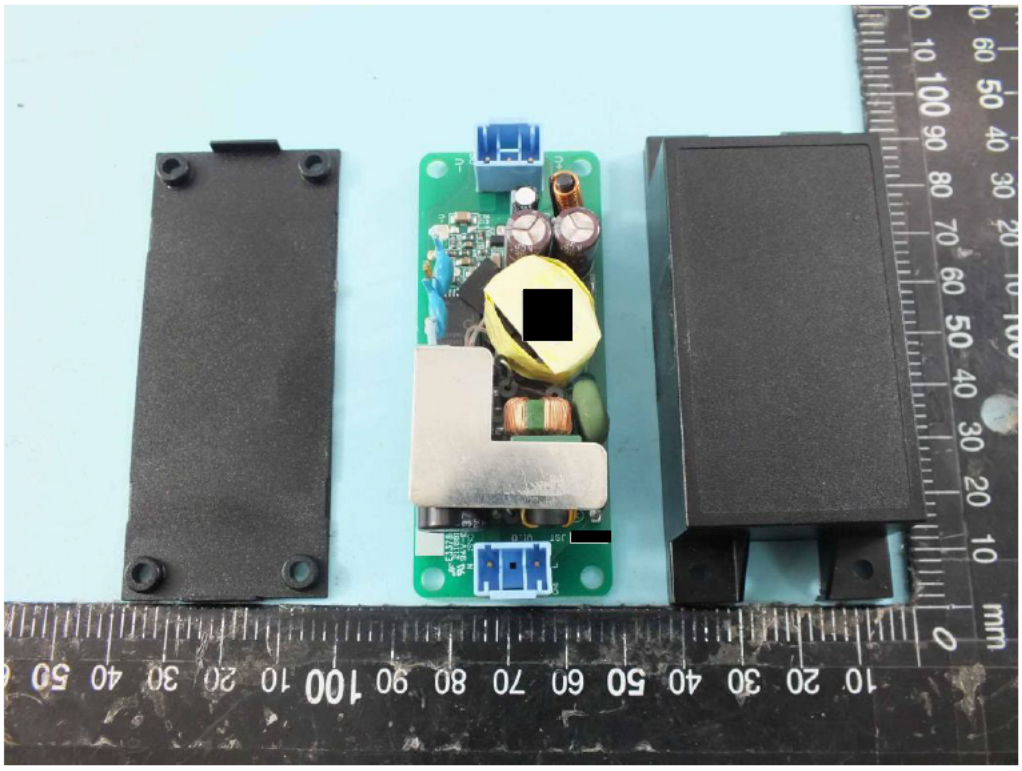

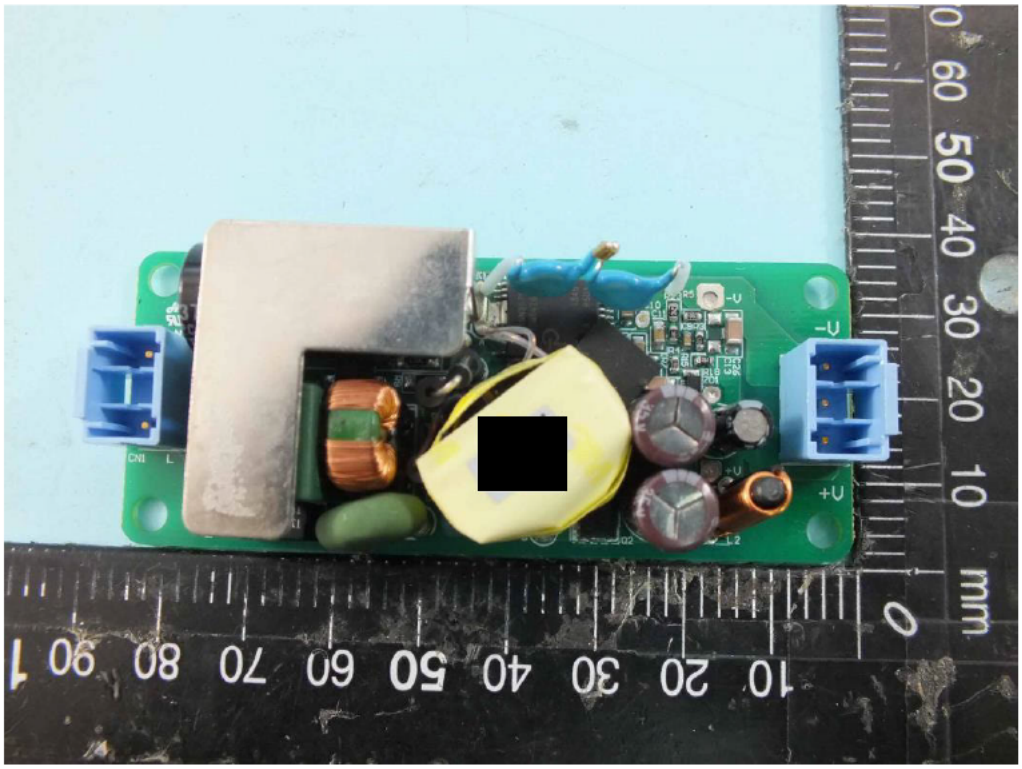

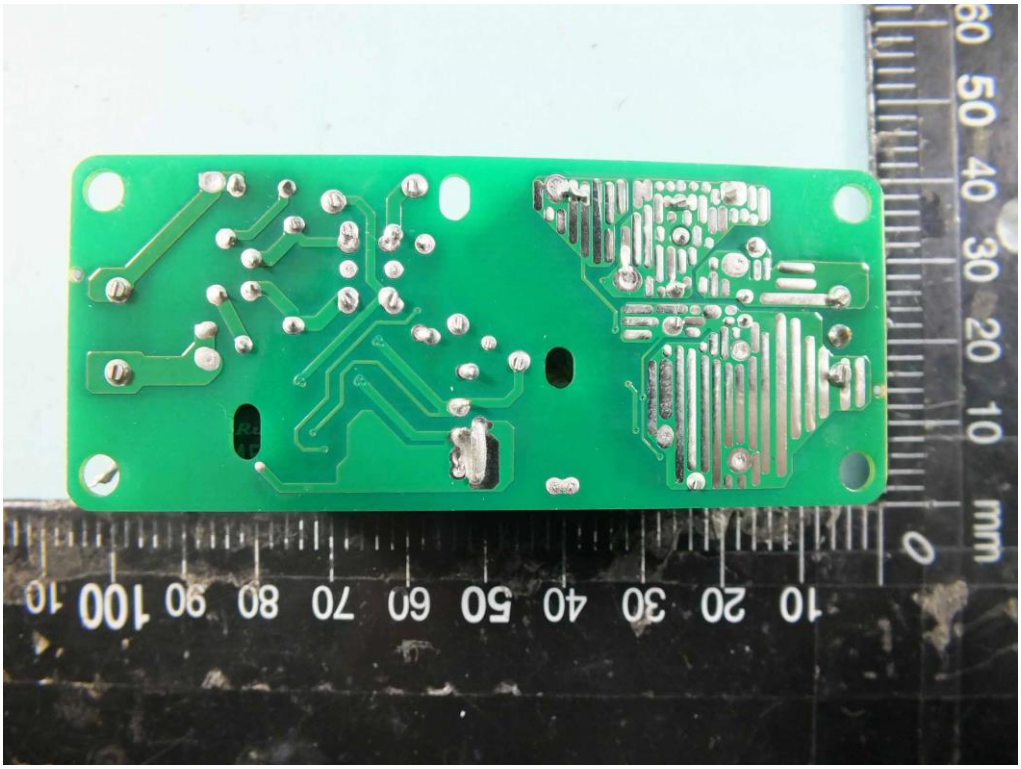

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