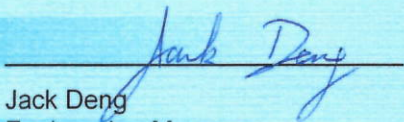


VERIFICATION OF COMPLIANCE

Equipment : AC-DC Switching Power Supply
TMLM 04103EI, TMLM 04105EI, TMLM 04108EI, TMLM
04109EI, TMLM 04112EI, TMLM 04114EI, TMLM 04115EI,
Model No. : TMLM 04124EI, TMLM 04253EI, TMLM 04285EI, TMLM
04225EI, TMLM 04103, TMLM 04105, TMLM 04108, TMLM
04109, TMLM 04112,
Applicant : Traco Electronic Co. Ltd.
Sihlbruggstrasse 111, 6340 Baar Switzerland

**I HEREBY****CERTIFY THAT:**

THE MEASUREMENTS SHOWN IN THIS TEST REPORT WERE MADE IN ACCORDANCE WITH THE PROCEDURES GIVEN IN **EUROPEAN COUNCIL DIRECTIVE 2004/108/EC**. THE EQUIPMENT WAS **PASSED** THE TEST PERFORMED ACCORDING TO **European Standard EN 55022:2010/AC:2011 Class B**, **EN 61000-3-2:2006/A1:2009 and /A2:2009**, **EN 61000-3-3:2008** and **EN 55024:2010 (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 2012-05**, **IEC 61000-4-5 Edition 2.0 2005-11**, **IEC 61000-4-6 Edition 3.0 2008-10**, **IEC 61000-4-8 Edition 2.0 2009-09**, **IEC 61000-4-11 Edition 2.0 2004-03**). THE TEST WAS CARRIED OUT ON **Dec. 18, 2013** AT **SPORTON INTERNATIONAL INC. LAB.**


Jack Deng
Engineering Manager

CE EMC TEST REPORT

according to

**European Standard EN 55022:2010/AC:2011 Class B,
EN 61000-3-2:2006/A1:2009 and /A2:2009, EN 61000-3-3:2008 and
EN 55024:2010 (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 2012-05,
IEC 61000-4-5 Edition 2.0 2005-11, IEC 61000-4-6 Edition 3.0 2008-10,
IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**

Equipment : AC-DC Switching Power Supply

Model No. : TMLM 04103EI, TMLM 04105EI, TMLM 04108EI, TMLM 04109EI,
TMLM 04112EI, TMLM 04114EI, TMLM 04115EI, TMLM 04124EI,
TMLM 04253EI, TMLM 04285EI, TMLM 04225EI, TMLM 04103,
TMLM 04105, TMLM 04108, TMLM 04109, TMLM 04112,
TMLM 04114, TMLM 04115, TMLM 04124, TMLM 04253,
TMLM 04285, TMLM 04225

Applicant : Traco Electronic Co. Ltd.
Sihlbruggstrasse 111, 6340 Baar Switzerland

Statement

- The test result refers exclusively to the test presented test model / sample.
- Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.
- This test report is only applicable to European Community.

SPORTON International Inc.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

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History of this test report

Report No.	Version	Issue Date	Description
EC3D0353-02	Rev.01	Oct. 07, 2014	Initial issue of report
EC3D0353-03	Rev.01	Jan. 27, 2015	Delete manufacturer

VERIFICATION OF COMPLIANCE

according to

**European Standard EN 55022:2010/AC:2011 Class B,
EN 61000-3-2:2006/A1:2009 and /A2:2009, EN 61000-3-3:2008 and
EN 55024:2010 (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 2012-05,
IEC 61000-4-5 Edition 2.0 2005-11, IEC 61000-4-6 Edition 3.0 2008-10,
IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**

Equipment : AC-DC Switching Power Supply

Model No. : TMLM 04103EI, TMLM 04105EI, TMLM 04108EI, TMLM 04109EI,
TMLM 04112EI, TMLM 04114EI, TMLM 04115EI, TMLM 04124EI,
TMLM 04253EI, TMLM 04285EI, TMLM 04225EI, TMLM 04103,
TMLM 04105, TMLM 04108, TMLM 04109, TMLM 04112,
TMLM 04114, TMLM 04115, TMLM 04124, TMLM 04253,
TMLM 04285, TMLM 04225

Applicant : Traco Electronic Co. Ltd.
Sihlbruggstrasse 111, 6340 Baar Switzerland

I **HEREBY** CERTIFY THAT :

The measurements shown in this test report were made in accordance with the procedures given in **EUROPEAN COUNCIL DIRECTIVE 2004/108/EC**. The equipment was **passed** the test performed according to **European Standard EN 55022:2010/AC:2011 Class B, EN 61000-3-2:2006/A1:2009 and /A2:2009, EN 61000-3-3:2008 and EN 55024:2010 (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 2012-05, IEC 61000-4-5 Edition 2.0 2005-11, IEC 61000-4-6 Edition 3.0 2008-10, IEC 61000-4-8 Edition 2.0 2009-09, IEC 61000-4-11 Edition 2.0 2004-03)**.
The product sample received on Dec. 12, 2013 and completely tested on **Dec. 18, 2013** at **SPORTON International Inc. LAB.**


Jack Deng
Engineering Manager

SPORTON International Inc.


No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

1. General Description of Equipment under Test

1.1. Applicant

Traco Electronic Co. Ltd.
Sihlbruggstrasse 111, 6340 Baar Switzerland

1.2. Basic Description of Equipment under Test

Equipment : AC-DC Switching Power Supply
Model No. : TMLM 04103EI, TMLM 04105EI, TMLM 04108EI, TMLM 04109EI,
TMLM 04112EI, TMLM 04114EI, TMLM 04115EI, TMLM 04124EI,
TMLM 04253EI, TMLM 04285EI, TMLM 04225EI, TMLM 04103,
TMLM 04105, TMLM 04108, TMLM 04109, TMLM 04112, TMLM 04114,
TMLM 04115, TMLM 04124, TMLM 04253, TMLM 04285, TMLM 04225
Trade Name :  **TRACO POWER**
Power Supply Type : Switching
AC Power Cord : Non-Shielded, 1.8 m, 2 pin
DC Power Cable : Non-Shielded, 0.65 m, 2 pin

1.3. Feature of Equipment under Test

Please refer to user manual.

2. Summary of the Test Result

2.1. Emission Tests

Emissions			
Test Standard	Description of Test	Result	Remark
EN 55022:2010/AC:2011	AC Power Conducted Emissions	Complies	-
EN 55022:2010/AC:2011	Telecommunication Ports Conducted	-	-
EN 55022:2010/AC:2011	Radiated Emissions (Below 1GHz)	Complies	-
	Radiated Emissions (Above 1GHz)	-	-
EN 61000-3-2:2006/A1:2009 and /A2:2009	Harmonic Current Emissions	-	-
EN 61000-3-3:2008	Voltage Fluctuations and Flicker	Complies	-

2.2. Immunity Tests

Applicable Standard : EN 55024:2010			
Test Standard	Description of Test	Result	Criteria
IEC 61000-4-2 Edition 2.0 2008-12	ESD (EUT of Enclosure)	Complies	B
IEC 61000-4-3 Edition 3.2 2010-04	RS (EUT of Enclosure)	Complies	A
IEC 61000-4-4 Edition 3.0 2012-05	EFT (EUT of AC Power Port)	Complies	B
IEC 61000-4-4 Edition 3.0 2012-05	EFT (EUT of signal ports and telecommunication ports)	-	-
IEC 61000-4-5 Edition 2.0 2005-11	Surge (EUT of AC Power Port)	Complies	B
IEC 61000-4-5 Edition 2.0 2005-11	Surge (EUT of signal ports and telecommunication ports)	-	-
IIEC 61000-4-6 Edition 3.0 2008-10	CS (EUT of AC Power Port)	Complies	A
IIEC 61000-4-6 Edition 3.0 2008-10	CS (EUT of signal ports and telecommunication ports)	-	-
IEC 61000-4-8 Edition 2.0 2009-09	PFMF (EUT of Enclosure)	Complies	A
IEC 61000-4-11 Edition 2.0 2004-03	DIP (EUT of AC Power Port)	Complies	C/C/B

3. Test Configuration of Equipment under Test

3.1. Test Manner

- a. The EUT has been associated with personal computer and peripherals pursuant to European Standard EN 55022 and EN 55024.
- b. The equipment under test were performed the following test modes:

Test Items	Description of test modes
AC Conducted Emission	Mode 1. FULL LOAD
Radiated Emissions	Mode 1. FULL LOAD
Harmonic and Flicker Emissions	Mode 1. FULL LOAD
EMS	Mode 1. FULL LOAD

- c. Frequency range investigated: Conduction 150 kHz to 30 MHz, Radiation 30 MHz to 1,000 MHz.
- d. Frequency range investigated immunity test: CS 150 kHz to 80 MHz, RS 80 MHz to 1,000 MHz.

3.2. Description of Test System

< EMI ><Conducted and Radiated below 1GHz>

No.	Peripheral	Manufacturer	Model Number	FCC ID	Cable / Spec. Description
For Local					
1	Dummy Load	SSR	-	-	400W / 8Ω

< EMS >

No.	Peripheral	Manufacturer	Model Number	FCC ID	Cable / Spec. Description
For Local					
1	Dummy Load	SSR	-	-	300W / 3Ω
2	Multi-meter	SUNWA	YX-360TR	-	Probe Cable, Non-Shielded, 1.0m

4. Test Software

No test software was used during testing.

5. General Information of Test

5.1. Test Facility

<EMI>

Test Site : SPORTON INTERNATIONAL INC.

Test Site Location : No. 3, Lane 238, Kang Lo Street, Nei Hwu District, Taipei 11424, Taiwan, R.O.C.

TEL : 886-2-2631-4739

FAX : 886-2-2631-9740

Test Site No. : CO01-NH, OS02-NH

<EMS>

Test Site Location : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiag, Tao Yuan Hsien, Taiwan, R.O.C.

TEL : 886-3-327-3456

FAX : 886-3-318-0055

5.2. Test Voltage

AC 230V / 50Hz

5.3. Measurement Procedure

EMI Test : European Standard EN 55022 Class B

Harmonics Test : European Standard EN 61000-3-2

Voltage Fluctuations Test : European Standard EN 61000-3-3

EMS Test : European Standard EN 55024

(ESD: IEC 61000-4-2, RS: IEC 61000-4-3, EFT: IEC 61000-4-4, SURGE: IEC 61000-4-5, CS: IEC 61000-4-6, Power Frequency Magnetic Field: IEC 61000-4-8, DIPS: IEC 61000-4-11)

5.4. Test in Compliance with

EMI Test : European Standard EN 55022 Class B

Harmonics Test : European Standard EN 61000-3-2

Voltage Fluctuations Test : European Standard EN 61000-3-3

EMS Test : European Standard EN 55024

(ESD: IEC 61000-4-2, RS: IEC 61000-4-3, EFT: IEC 61000-4-4, SURGE: IEC 61000-4-5, CS: IEC 61000-4-6, Power Frequency Magnetic Field: IEC 61000-4-8, DIPS: IEC 61000-4-11)

5.5. Frequency Range Investigated

a. Conducted emission test: from 150 kHz to 30 MHz

b. Radiated emission test: from 30 MHz to 1,000 MHz

c. Radio frequency electromagnetic field immunity test: 80-1000 MHz

5.6. Test Distance

- a. The test distance of radiated emission test from antenna to EUT is 10 M.
- b. The test distance of radio frequency electromagnetic field immunity test from antenna to EUT is 3 M.

6. Conducted Emissions Measurement

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 kHz and return leads of the EUT according to the methods defined in European Standard EN 55022 Clause 9. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meter above the ground plane as shown in section 6.4. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position producing maximum conducted emissions.

6.1. Limits for conducted disturbance at mains terminals and telecommunication ports

Limits for conducted disturbance at mains terminals

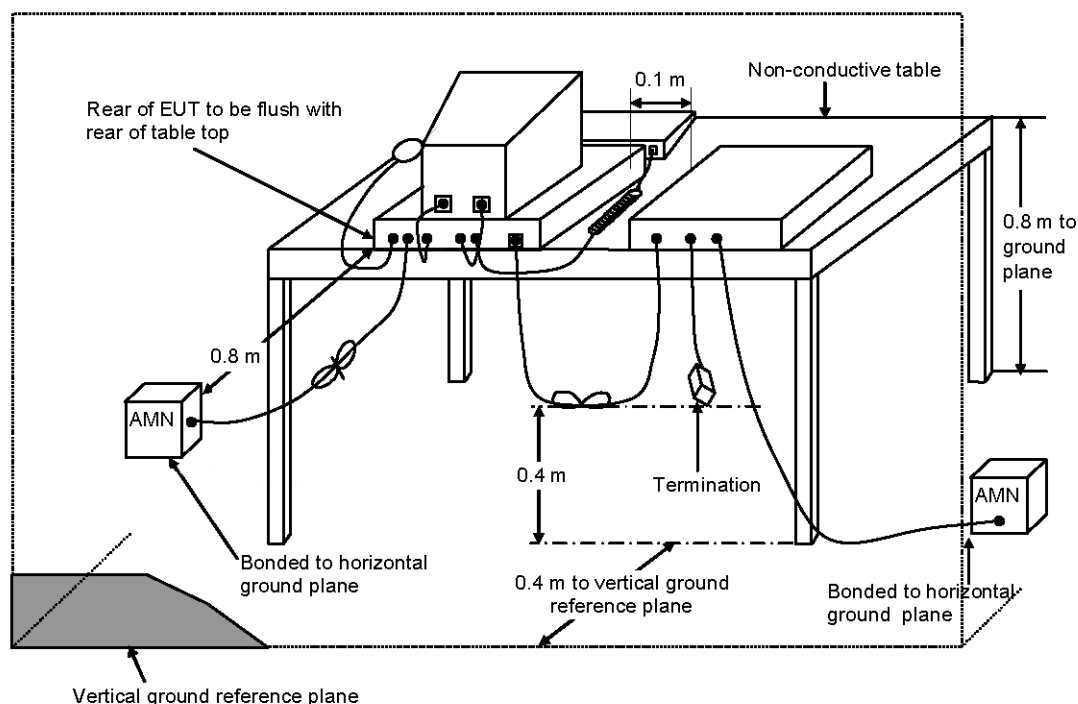
Frequency range (MHz)	Class A Limits dB(μV)		Class B Limits dB(μV)	
	Quasi-peak	Average	Quasi-peak	Average
0.15 to 0.50	79	66	66 - 56	56 - 46
0.50 to 5	73	60	56	46
5 to 30	73	60	60	50

NOTE: The limits decrease linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

6.2. Test Procedures

- The EUT was warmed up for 15 minutes before testing started.
- 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.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connect to the other LISN.
- The LISN provides 50 ohm, coupling impedance for the measuring instrument.
- The CISPR states that a 50 ohm, 50 microhenry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

6.3. Typical Test Setup Layout of AC Powerline Conducted Emissions

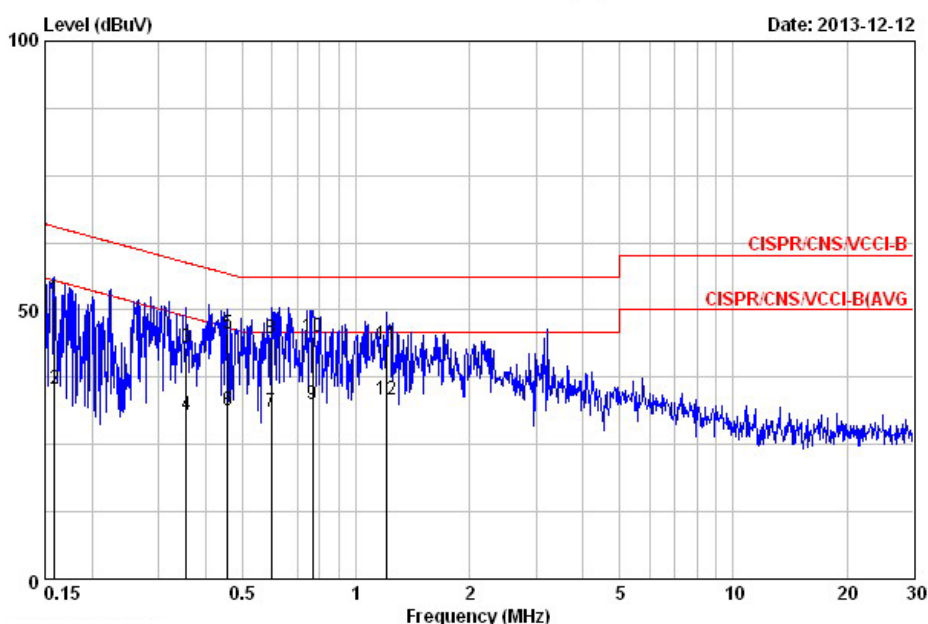


- AMN is 80 cm from the EUT and at least 80 cm from other units and other metal planes.
- EUT is connected to one artificial mains network (AMN).
- All other units of a system are powered from a second AMN. A multiple outlet strip can be used for multiple mains cords.
- Rear of EUT to be flushed with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

6.4. Test Result of AC Powerline Conducted Emission

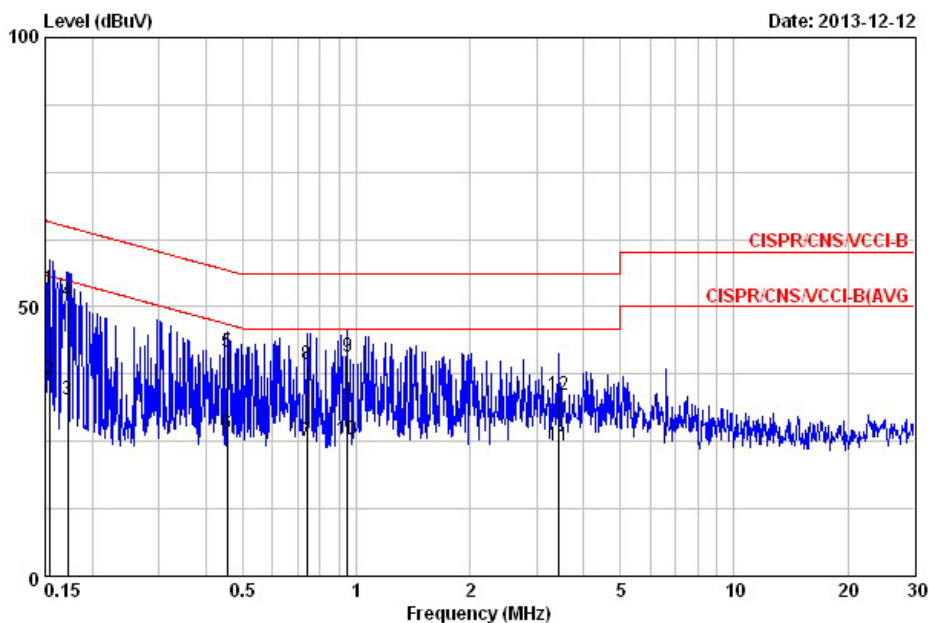
Test Mode	Mode 1	Test Site No.	CO01-NH
Test Frequency	0.15 MHz ~ 30 MHz	Test Engineer	Will
Temperature	22 °C	Relative Humidity	54 %
Note: 1. Corrected Reading (dBμV) = LISN Factor + Cable Loss + Read Level = Level			
2. All emissions not reported here are more than 10 dB below the prescribed limit.			
■ 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	dBμV	dB	dBμV	dBμV	dB	dB	
1	0.159	52.14	-13.38	65.52	41.87	10.17	0.10	QP
2	0.159	35.33	-20.19	55.52	25.06	10.17	0.10	AVERAGE
3	0.356	43.14	-15.68	58.83	32.87	10.17	0.10	QP
4	0.356	30.38	-18.44	48.83	20.11	10.17	0.10	AVERAGE
5 ☺	0.456	45.57	-11.19	56.76	35.29	10.17	0.10	QP
6	0.456	31.38	-15.38	46.76	21.10	10.17	0.10	AVERAGE
7	0.598	31.11	-14.89	46.00	20.83	10.18	0.10	AVERAGE
8 ☺	0.598	44.86	-11.14	56.00	34.58	10.18	0.10	QP
9	0.767	32.57	-13.43	46.00	22.28	10.18	0.10	AVERAGE
10 ☺	0.767	45.04	-10.96	56.00	34.75	10.18	0.10	QP
11 ☺	1.203	43.69	-12.31	56.00	33.37	10.20	0.13	QP
12	1.203	33.31	-12.69	46.00	22.99	10.20	0.13	AVERAGE

Neutral



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.154	53.20	-12.58	65.78	42.96	10.14	0.10	QP
2	0.154	36.45	-19.33	55.78	26.21	10.14	0.10	AVERAGE
3	0.172	32.76	-22.10	54.86	22.52	10.14	0.10	AVERAGE
4	0.172	51.13	-13.73	64.86	40.89	10.14	0.10	QP
5	0.454	41.46	-15.35	56.80	31.21	10.14	0.10	QP
6	0.454	26.44	-20.37	46.80	16.19	10.14	0.10	AVERAGE
7	0.739	25.08	-20.92	46.00	14.84	10.15	0.10	AVERAGE
8	0.739	39.20	-16.80	56.00	28.96	10.15	0.10	QP
9	0.948	40.73	-15.27	56.00	30.48	10.15	0.10	QP
10	0.948	25.25	-20.75	46.00	15.00	10.15	0.10	AVERAGE
11	3.417	24.24	-21.76	46.00	13.85	10.19	0.20	AVERAGE
12	3.417	33.52	-22.48	56.00	23.13	10.19	0.20	QP

7. Radiated Emission Measurement

Radiated emissions from 30 MHz to 1,000 MHz were measured with a bandwidth of 120 kHz for 30 MHz to 1,000 MHz and 1 MHz for above 1GHz according to the methods defines in European Standard EN 55022, Clause 10. The EUT was placed on a nonmetallic stand, 0.8 meter above the ground plane, as shown in section 7.4. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions.

7.1. Limits for radiated disturbance

Limits for radiated disturbance at a measuring distance of 10 m

Frequency range (MHz)	Class A	Class B
	Quasi-peak limits dB(μV/m)	Quasi-peak limits dB(μV/m)
30 to 230	40	30
230 to 1000	47	37

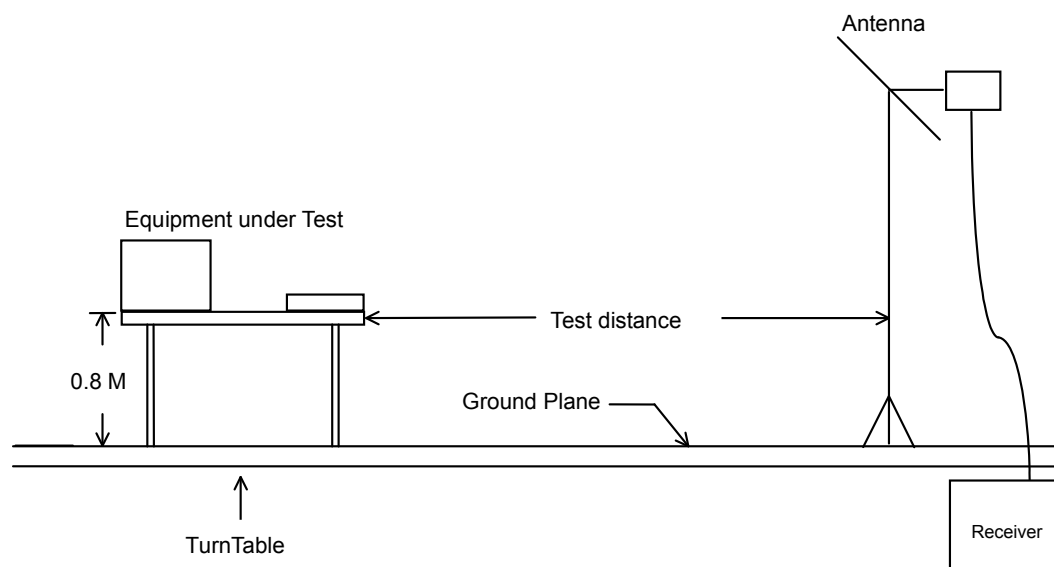
7.2. Test Procedures

For Below 1GHz

- The EUT was placed on a rotatable table top 0.8 meter above ground.
- The EUT was set 10 meters from the interference-receiving antenna which was mounted on the top of a variable height antenna tower.
- The table was rotated 360 degrees to determine the position of the highest radiation.
- 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.
- 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.
- Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- 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.

7.3. Typical Test Setup Layout of Radiated Emissions

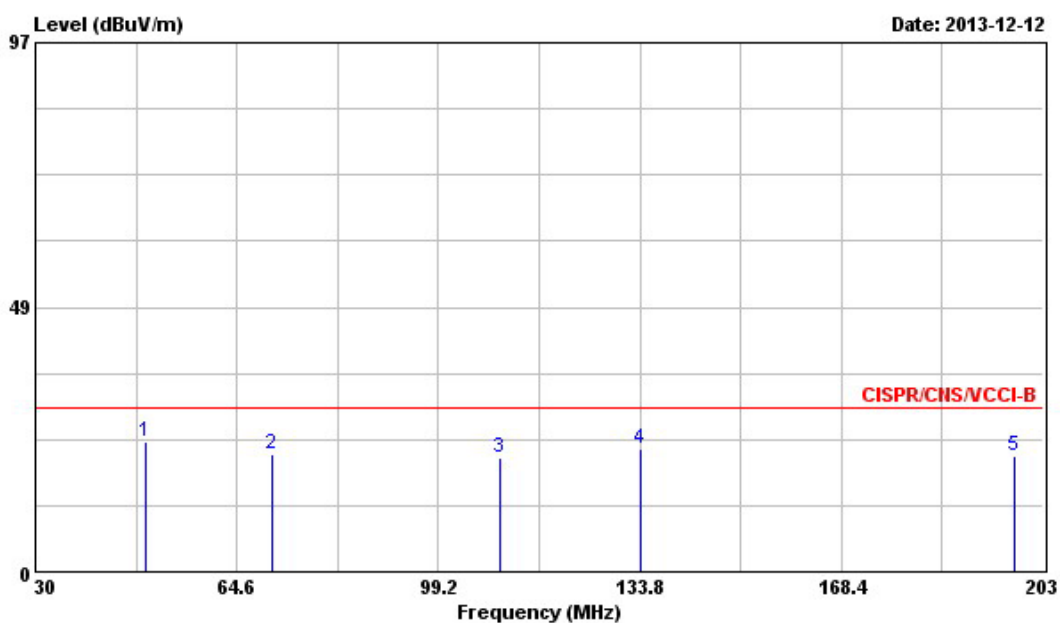
For Below 1GHz



7.4. Test Result of Radiated Emission for Below 1GHz

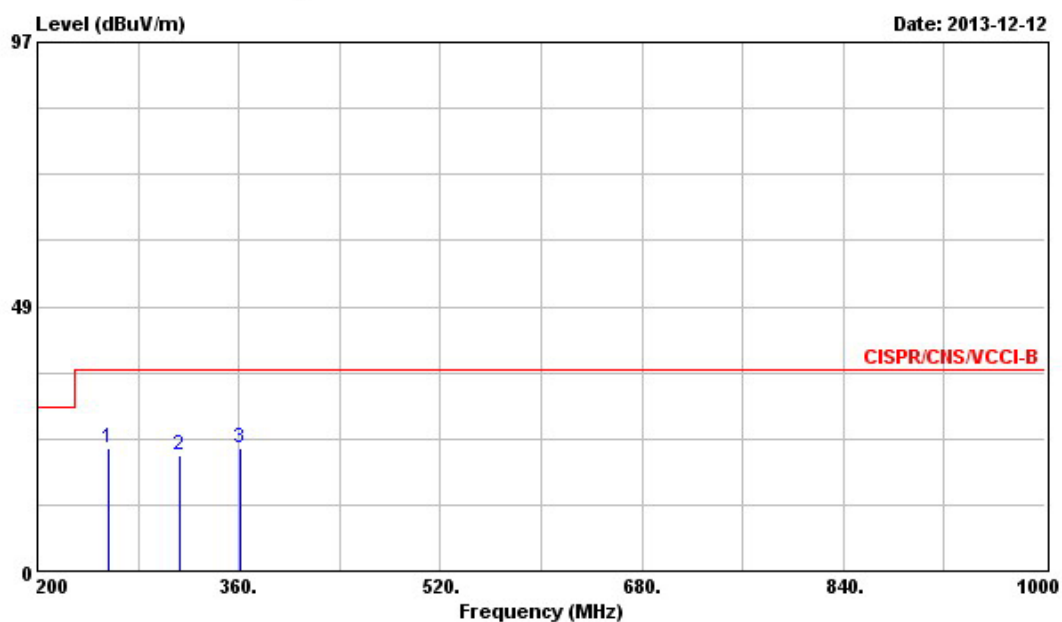
Test mode	Mode 1	Test Site No.	OS02-NH
Test frequency	30 MHz ~ 1000 MHz	Test Engineer	Louis
Temperature	20 °C	Relative Humidity	50 %
Note: 1. Emission level (dB μ V/m) = 20 log Emission level (μ V/m)			
2. Corrected Reading : Antenna Factor + Cable Loss + Read Level – Preamp Factor = Level			
■ The test was passed at the minimum margin that marked by the frame in the following data			

Vertical



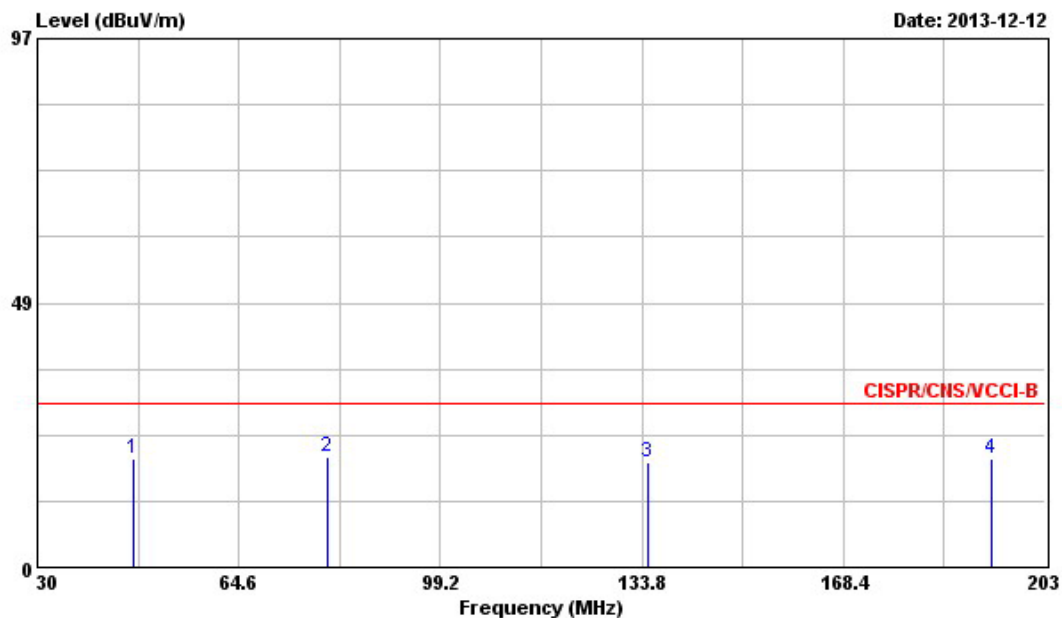
	Freq	Level	Over	Limit	Read	Antenna	Cable	Preamp		Ant	Table
	MHz	dB μ V/m	Limit	Line	Level	Factor	Loss	Factor	Remark	Pos	Pos
			dB	dB μ V/m	dB μ V	dB/m	dB	dB		cm	deg
1	49.030	23.84	-6.16	30.00	45.28	9.34	0.95	31.73	Peak	100	180
2	70.660	21.46	-8.54	30.00	45.15	6.89	1.10	31.68	Peak	---	---
3	109.750	20.94	-9.06	30.00	39.60	11.59	1.33	31.58	Peak	---	---
4	133.970	22.44	-7.56	30.00	40.93	11.57	1.45	31.51	Peak	---	---
5	198.160	21.36	-8.64	30.00	41.74	9.19	1.78	31.35	Peak	---	---

Vertical



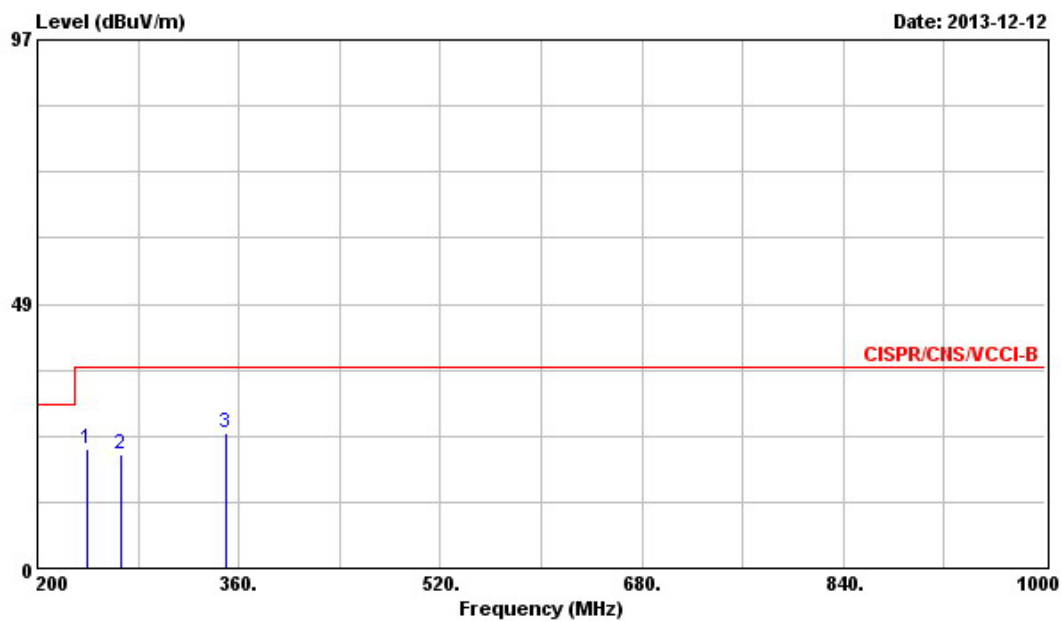
	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	256.800	22.63	-14.37	37.00	39.41	12.47	2.04	31.29	Peak	---	---
2	312.800	21.21	-15.79	37.00	36.59	13.62	2.26	31.26	Peak	---	---
3	360.800	22.38	-14.62	37.00	36.42	14.82	2.44	31.30	Peak	---	---

Horizontal



	Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp		Ant	Table
	MHz	dBuV/m	Limit	Line	Level	Factor	Loss	Factor	Pos	Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cm	deg
1	46.440	19.91	-10.09	30.00	40.42	10.29	0.92	31.72	Peak	---
2	79.820	20.37	-9.63	30.00	43.73	7.14	1.16	31.66	Peak	---
3	134.840	19.24	-10.76	30.00	37.80	11.49	1.46	31.51	Peak	---
4	193.830	19.93	-10.07	30.00	40.32	9.21	1.76	31.36	Peak	---

Horizontal



	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark	Ant Pos	Table Pos
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB		cm	deg
1	239.200	22.03	-14.97	37.00	39.69	11.67	1.97	31.30	Peak	---	---
2	266.400	21.06	-15.94	37.00	37.61	12.65	2.08	31.28	Peak	---	---
3	349.600	24.66	-12.34	37.00	39.05	14.52	2.39	31.30	Peak	---	---

8. Harmonic Current Emissions Measurement

As specified on clause 7 of EN 61000-3-2, the limits are not specified for equipment with a rated power of 75W or less.

The EUT meets the above condition, so it conforms to EN 61000-3-2.

9. Voltage Fluctuations and Flicker Measurement

9.1. Standard

- Product Standard : EN 61000-3-3

9.2. Test Procedure

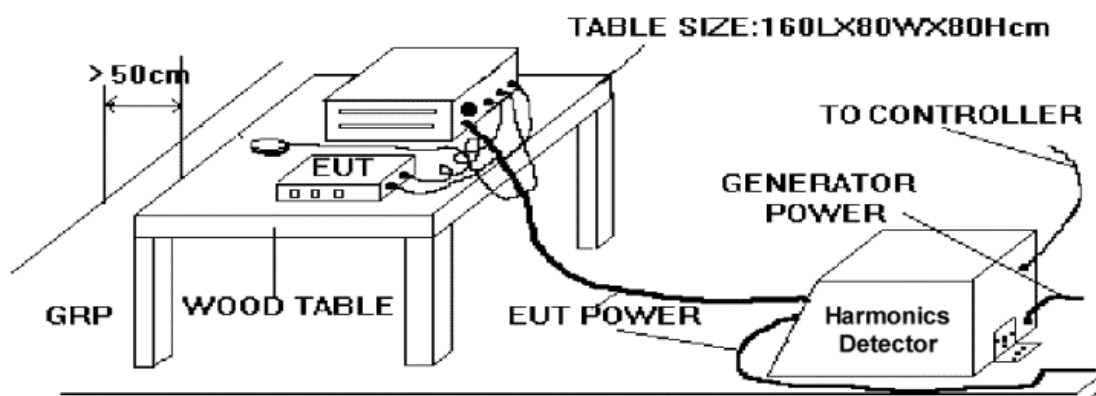
The equipment shall be tested under the conditions of **Clause 5**.

The total impedance of the test circuit, excluding the appliance under test, but including the internal impedance of the supply source, shall be equal to the reference impedance. The stability and tolerance of the reference impedance shall be adequate to ensure that the overall accuracy of $\pm 8\%$ is achieved during the whole assessment procedure.

9.3. 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

9.4. Typical Test Setup Layout of Voltage Fluctuations and Flicker



9.5. Test Result of Voltage Fluctuation and Flicker

Test mode	Mode 1		
Temperature	25 °C	Final Test Result	<u>PASS</u>
Relative Humidity	48 %	Test Date	Dec. 18, 2013
Atmospheric Pressure	102 kPa	Test Engineer	Eric

Parameter values recorded during the test:

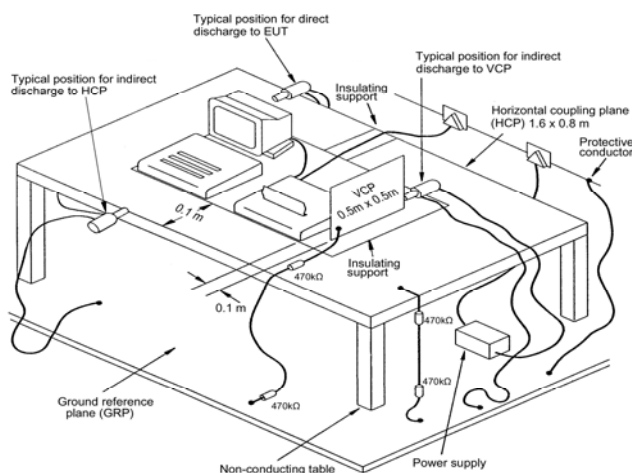
Vrms at the end of test (Volt): 230.36

Highest dt (%):	0.00	Test limit (%):	3.30	Pass
Time(mS) > dt:	0.0	Test limit (mS):	500.0	Pass
Highest dc (%):	0.00	Test limit (%):	3.30	Pass
Highest dmax (%):	0.00	Test limit (%):	4.00	Pass
Highest Pst (10 min. period):	0.073	Test limit:	1.000	Pass

10. Electrostatic Discharge Immunity Measurement (ESD)

- | | |
|---------------------------------|--|
| ● Final Test Result | : <u>PASS</u> |
| ● Pass Performance Criteria | : <u>A</u> |
| ● Required Performance Criteria | : B |
| ● Basic Standard | : IEC 61000-4-2 |
| ● Product Standard | : EN 55024:2010 |
| ● Level | : 3 for air discharge |
| | : 2 for contact discharge |
| ● Test Voltage | : $\pm 2 / \pm 4 / \pm 8$ kV for air discharge |
| | : $\pm 2 / \pm 4$ kV for contact discharge |
| ● Discharge Impedance | : 330 ohm / 150 pF |
| ● Temperature | : 26 °C |
| ● Relative Humidity | : 47 % |
| ● Atmospheric Pressure | : 102 kPa |
| ● Test Date | : Dec. 18, 2013 |
| ● Test Engineer | : Eric |

10.1. 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.

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

10.3. ESD 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. The test shall be performed with both air discharge and contact discharge. On preselected points at least 10 single discharges (in the most sensitive polarity) shall be applied on air discharge. On preselected points at least 25 single discharges (in the most sensitive polarity) shall be applied on contact discharge.
- e. 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.
- f. In the case of contact discharges, the tip of the discharge electrode shall touch the EUT before the discharge switch is operated.
- g. 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.
- h. 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.

10.4. Test Severity Levels

10.4.1. Contact Discharge

Level	Test Voltage (kV) of Contact discharge
1	± 2
2	± 4
3	± 6
4	± 8
X	Specified
Remark : "X" is an open level.	

10.4.2. Air Discharge

Level	Test Voltage (kV) of Air Discharge
1	± 2
2	± 4
3	± 8
4	± 15
X	Specified
Remark : "X" is an open level.	

10.5. Test Points

10.5.1. Test Result of Air Discharge

No Discharge

10.5.2. Test Result of Contact Discharge

Direct discharge

Test Method	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
DC OUTPUT	25	A	A	A	A	Normal

Indirect discharge to HCP and VCP

Test Method	No. of Discharges	Contact Discharge/Pointed Tip				Test Record
		+2kV	-2kV	+4kV	-4kV	
HCP (At Front)	25	A	A	A	A	Normal
HCP (At Left)	25	A	A	A	A	Normal
HCP (At Right)	25	A	A	A	A	Normal
HCP (At Rear)	25	A	A	A	A	Normal
VCP (At Front)	25	A	A	A	A	Normal
VCP (At Left)	25	A	A	A	A	Normal
VCP (At Right)	25	A	A	A	A	Normal
VCP (At Rear)	25	A	A	A	A	Normal

11. Radio Frequency Electromagnetic Field Immunity Measurement (RS)

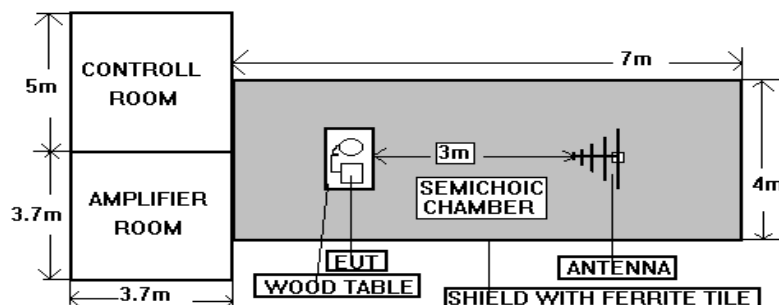
- Final Test Result : **PASS**
- Pass Performance Criteria : **A**
- Required Performance Criteria : A
- Basic Standard : IEC 61000-4-3
- Product Standard : EN 55024:2010
- Level : 2
- Frequency Range : 80-1000 MHz
- Dwell Time : 2.9 seconds
- Frequency Step size : 1 % of the preceding frequency value
- Field Strength : 3 V/m (unmodulated, r.m.s) 80% AM (1 kHz)
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

11.1. Test Record

Frequency Band: 80-1000 MHz

Sides of the EUT have been exposed to the field	Antenna positioned	Test field strength Level	Test field strength (V/m)	Test Record
Front	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Left	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Back	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)
Right	Vertical	2	3	Normal (No influencing)
	Horizontally	2	3	Normal (No influencing)

11.2. 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.

11.3. Test Procedure

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

11.4. Test Severity Levels

Frequency Band : 80-1000MHz

Level	Test field strength (V/m)
1	1
2	3
3	10
X	Specified
Remark : "X" is an open class.	

12. Electrical Fast Transient/Burst Immunity Measurement (EFT/BURST)

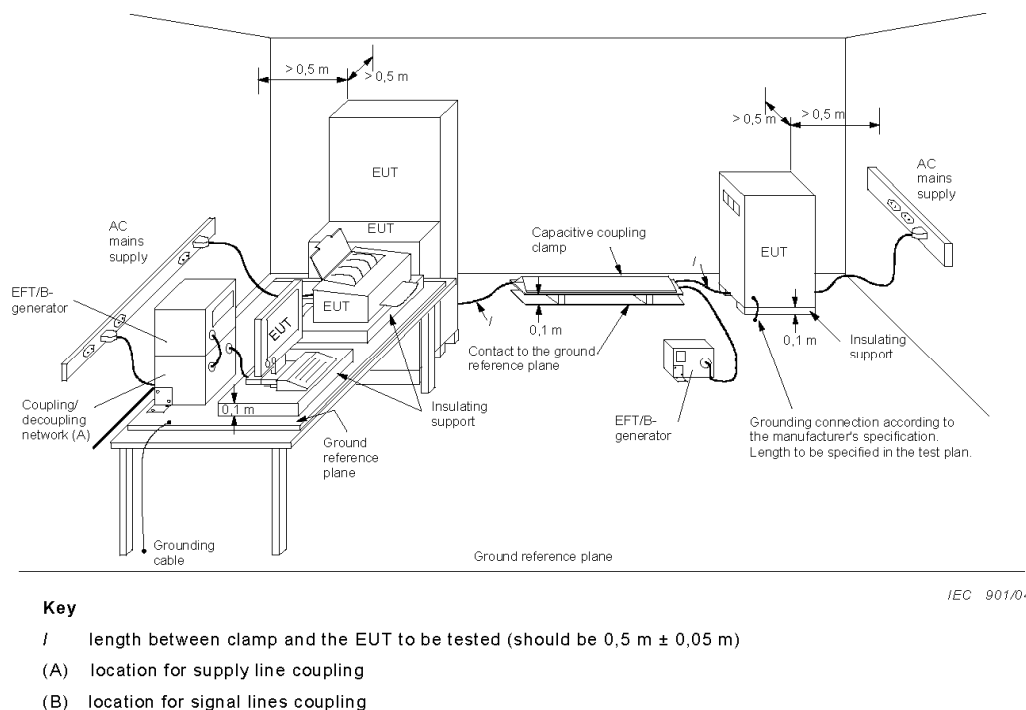
- Final Test Result : **PASS**
- Pass Performance Criteria : **A**
- Required Performance Criteria : B
- Basic Standard : IEC 61000-4-4
- Product Standard : EN 55024:2010
- Level : on Input power ports -- 2
- Test Voltage : on Input power ports -- $\pm 0.5 / \pm 1.0$ kV
- Impulse wave shape : 5/50 ns (Tr/Th)
- Impulse frequency : 5 kHz
- Test Repetition Rate : 1 time / minute
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

12.1. Test Record

■ on Input power ports:

Test Location	Polarity	Test Level	Voltage (Peak)	Test Record
L	+	2	0.5 / 1.0 kV	Normal (No influencing)
	—	2	0.5 / 1.0 kV	Normal (No influencing)
N	+	2	0.5 / 1.0 kV	Normal (No influencing)
	—	2	0.5 / 1.0 kV	Normal (No influencing)
L+N	+	2	0.5 / 1.0 kV	Normal (No influencing)
	—	2	0.5 / 1.0 kV	Normal (No influencing)

12.2. Test setup



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 1 m or less.

12.3. 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 1 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.

12.4. 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.

12.5. Test Procedure

- a. In order to minimize the effect of environmental parameters on test results, the climatic conditions when test is carrying out shall comply with the following requirements:
 - ambient temperature: 15 °C to 35 °C;
 - relative humidity : 45 % to 75 %;
 - atmospheric pressure : 86 kPa (860 mbar) to 106 kPa (1060 mbar).
- b. In order to minimize the effect of environmental parameters on test results, the electromagnetic environment of the laboratory shall not influence the test results.
- c. 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.
- d. 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).

12.6. Test Severity Levels

The following test severity levels are recommended for the fast transient/burst test :

Open circuit output test voltage $\pm 10\%$		
Level	On Input power ports	On signal port and telecommunication ports
1	0.5 kV	0.25 kV
2	1.0 kV	0.50 kV
3	2.0 kV	1.00 kV
4	4.0 kV	2.00 kV
X	Specified	Specified
Remark : " X " is an open level. The level is subject to negotiation between the user and the manufacturer or is specified by the manufacturer.		

13. Surge Immunity Measurement

- Final Test Result : **PASS**
- Pass Performance Criteria : **A**
- Required Performance Criteria : B for Input power ports
- Basic Standard : IEC 61000-4-5
- Product Standard : EN 55024:2010
- Surge wave form (Tr/Th) : on Input power ports -- 1.2/50 (8/20) μ s
- Level : on Input power ports -- 3
- Test Voltage : on Input power ports -- $\pm 1.0 / \pm 2.0$ kV
- Phase Angle : 0°, 90°, 180°, 270°
- Number of surges : 5 positive and 5 negative pulses
- Pulse Repetition Rate : 1 time / min. (maximum)
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

13.1. Test Record

■ on Input power ports:

Test Location	Voltage (kV)	Polarity	Phase Angle				Test Record
			0°	90°	180°	270°	
L - N	0.5	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)
	1.0	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)
L - PE	1.0	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)
	2.0	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)
N - PE	1.0	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)
	2.0	+	A	A	A	A	Normal (No influencing)
		-	A	A	A	A	Normal (No influencing)

Remark : PE = Earth reference

13.2. Test Severity Levels

Level	Open-circuit test voltage, $\pm 10\%$, kV
1	0.5
2	1.0
3	2.0
4	4.0
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

13.3. Test Procedure

- a. Climatic conditions
The climatic conditions shall comply with the following requirements :
 - ambient temperature : 15 °C to 35 °C
 - relative humidity : 10 % to 75 %
 - atmospheric pressure : 86 kPa to 106 kPa (860 mbar to 1060 mbar).
- b. Electromagnetic conditions
The electromagnetic environment of the laboratory shall not influence the test results.
- c. 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.
- d. 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).
- e. 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.

- f. 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.
- g. 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.
- h. If the actual operating signal sources are not available, they may be simulated. Under no circumstances may the test level exceed the product specification. The test shall be carried out according to the test plan.
- i. 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 and the protection devices shall be replaced.

13.4. Operating Condition

Full system

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

- Final Test Result : **PASS**
- Pass Performance Criteria : **A**
- Required Performance Criteria : A
- Basic Standard : IIEC 61000-4-6
- Product Standard : EN 55024:2010
- Level : 2
- Test Voltage : 3 V (unmodulated, r.m.s) 80% AM (1 kHz)
- Frequency Range : 0.15 MHz to 80 MHz
- Dwell time : 2.9 seconds
- Frequency step size : 1 % of the preceding frequency value
- Test Port : on Input power ports
- Coupling mode : CDN-M016 for Input power port
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

14.1. Test Record

Test Port	Test field strength level	Test field strength (V rms)	Test Record
Input power port	2	3	Normal (No influencing)

14.2. Test Severity Levels

Level	Voltage Level (EMF)
1	1 V rms
2	3 V rms
3	10 V rms
x	Specified
Remark : " X " is an open level. This level can be specified in the product specification.	

14.3. Operating Condition

Full system

14.4. 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.

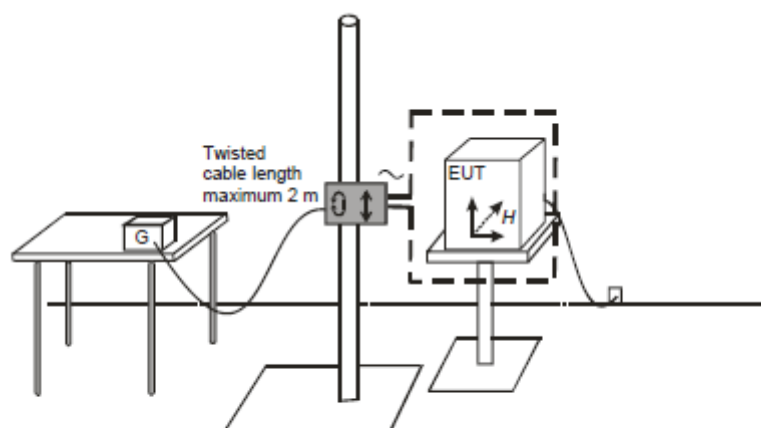
15. Power Frequency Magnetic Field immunity Measurement (PFMF)

- Final Test Result : **PASS**
- Pass Performance Criteria : **A**
- Required Performance Criteria : A
- Basic Standard : IEC 61000-4-8
- Product Standard : EN 55024:2010
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

15.1. Test Record

Power Frequency Magnetic Field	Testing duration	Coil Orientation	Test Record
50/60Hz, 1A/m	1.0 Min	X-axis	Normal (No influencing)
50/60Hz, 1A/m	1.0 Min	Y-axis	Normal (No influencing)
50/60Hz, 1A/m	1.0 Min	Z-axis	Normal (No influencing)

15.2. Test Setup



EUT : Equipment under test G : Test Generator

16. Voltage Dips and Voltage Interruptions Immunity Measurement (DIP)

- Final Test Result : **PASS**
- Pass Performance Criteria : **C** for voltage interruption, **A/A** for voltage dips
- Required Performance Criteria : C for voltage interruption, C/B for voltage dips
- Basic Standard : IEC 61000-4-11
- Product Standard : EN 55024:2010
- Test Port : Input power ports
- Phase Angle : 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360°
- Temperature : 26 °C
- Relative Humidity : 47 %
- Atmospheric Pressure : 102 kPa
- Test Date : Dec. 18, 2013
- Test Engineer : Eric

16.1. Test Record of Voltage Interruption

Voltage (V)	Performance Criterion (Phase Angle)									Reduction Voltage	Duration (Periods)
	0°	45°	90°	135°	180°	225°	270°	315°	360°		
100/240	C	C	C	C	C	C	C	C	C	>95 %	250
Observation	After the interruption, the power of EUT was off. The power of the EUT must be reset by the operator.										

16.2. Test Record of Voltage Dips

Voltage (V)	Performance Criterion (Phase Angle)									Reduction Voltage	Duration (Periods)
	0°	45°	90°	135°	180°	225°	270°	315°	360°		
100/240	A	A	A	A	A	A	A	A	A	30 %	25
100/240	A	A	A	A	A	A	A	A	A	>95 %	0.5
Observation	Normal (No influencing)										

16.3. Testing Requirement and Procedure

The test was based on IEC 61000-4-11

16.4. Test Conditions

- a. Source voltage and frequency : 100/240V, 50Hz, Single phase.
- b. Test of interval : 10 sec.
- c. Level and duration : Sequency of 3 dips/interrupts.
- d. Voltage rise (and fall) time : 1 ~ 5 μ s.

16.5. Operating Condition

Full system

17. Photographs of Test Configuration

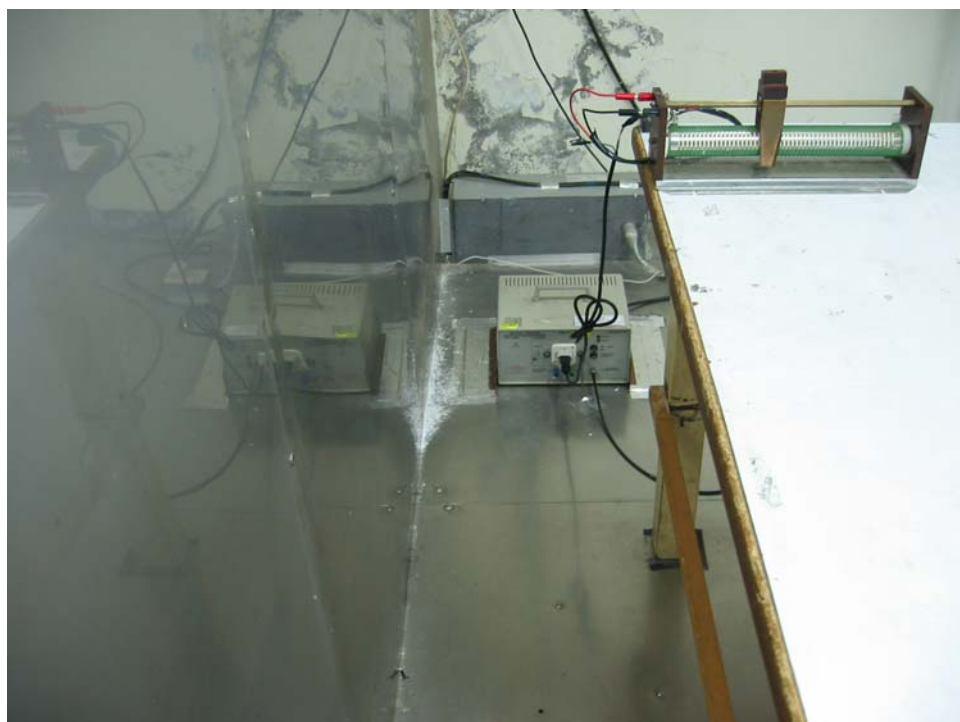
17.1. Photographs of AC Powerline Conducted Emissions Test Configuration

- The photographs show the configuration that generates the maximum emission.

FRONT VIEW



REAR VIEW



17.2. Photographs of Radiated Emissions Test Configuration

- The photographs show the configuration that generates the maximum emission.
For Below 1GHz

FRONT VIEW



REAR VIEW

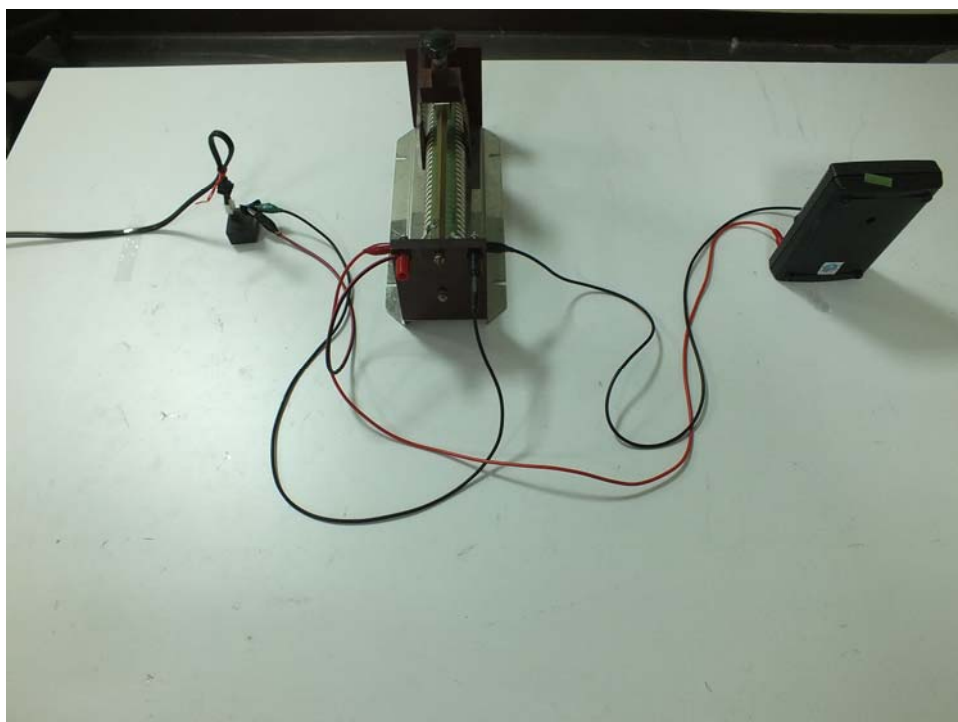


17.3. Photographs of Harmonic, Flicker, Surge, Dip Test Configuration

FRONT VIEW



REAR VIEW



17.4. Photographs of ESD Immunity Test Configuration

FRONT VIEW

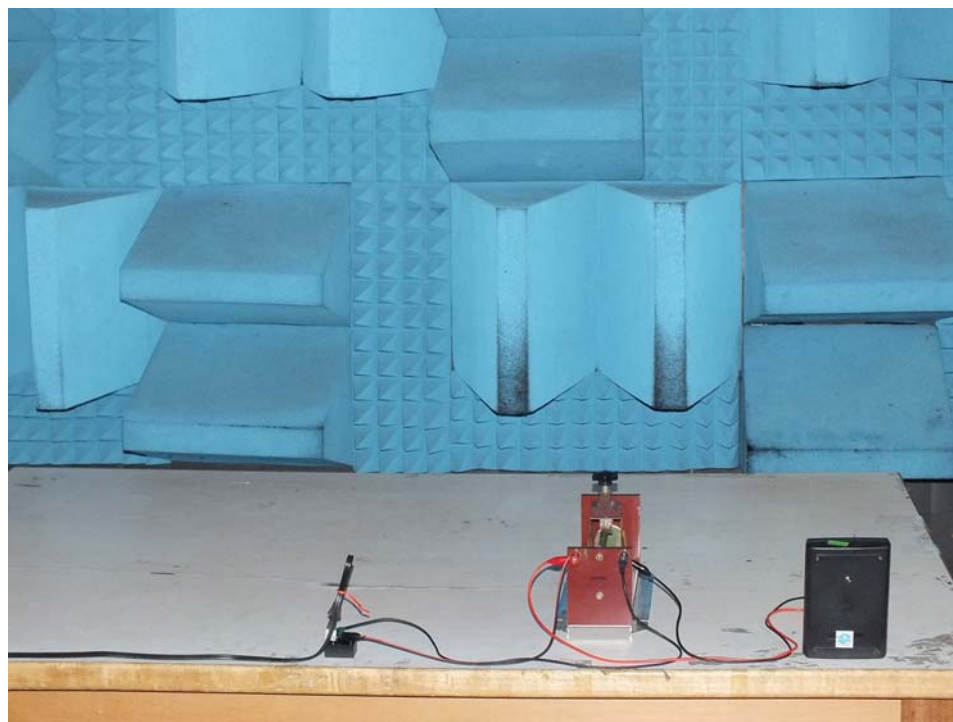


REAR VIEW

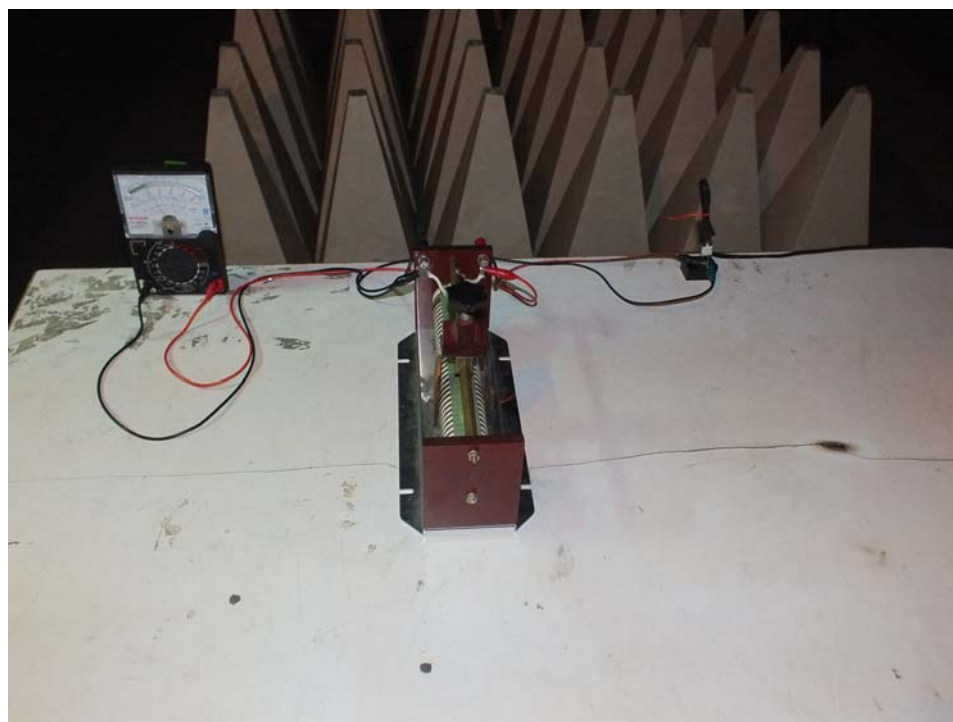


17.5. Photographs of RS Immunity Test Configuration

FRONT VIEW

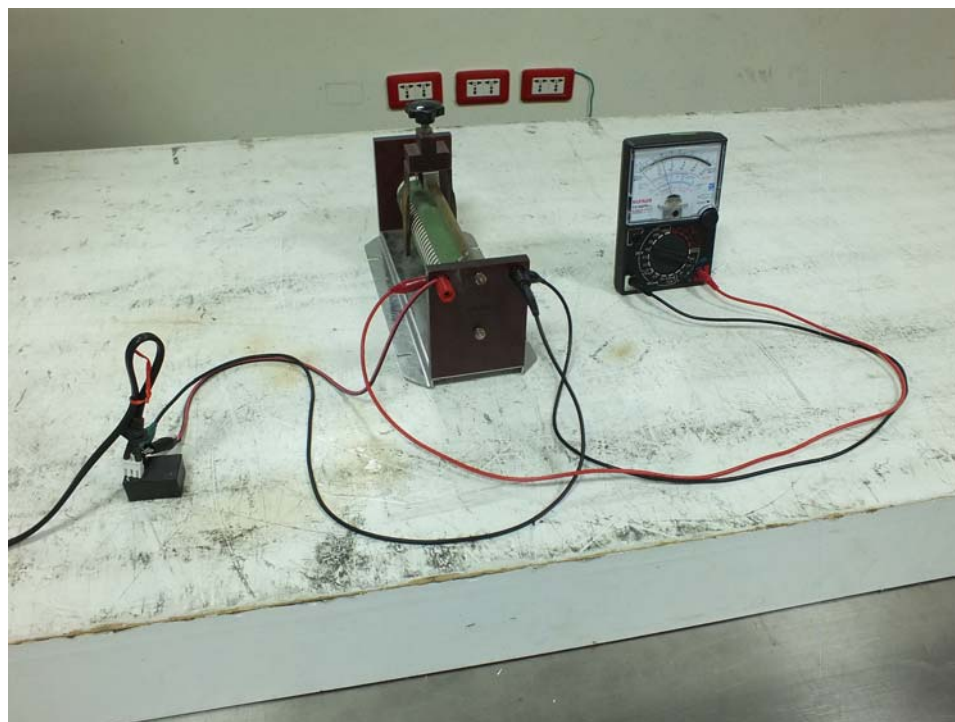


REAR VIEW

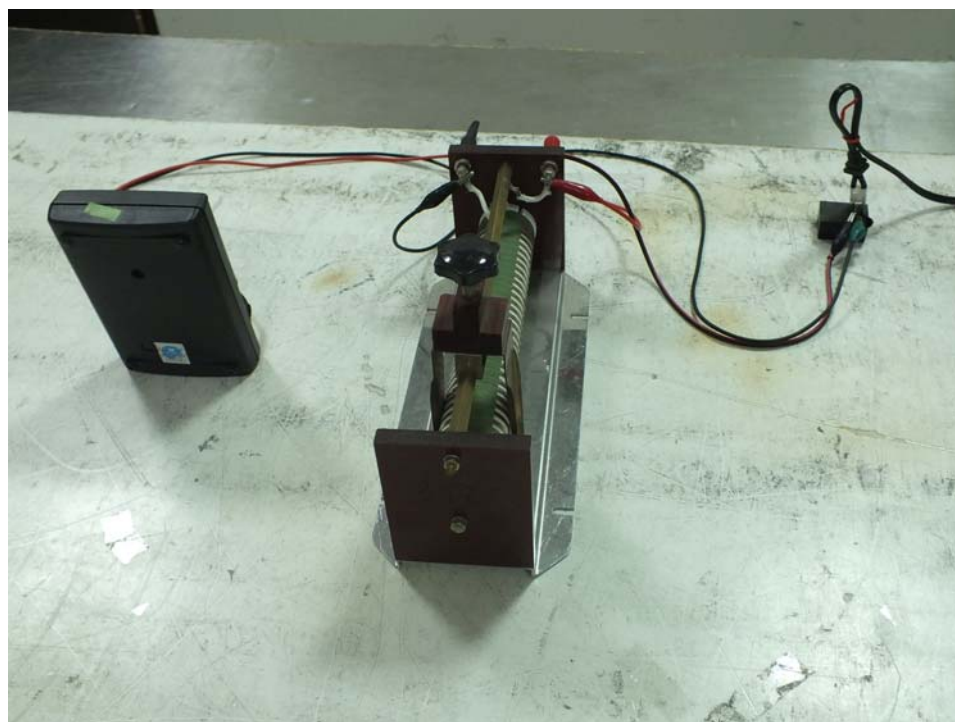


17.6. Photographs of EFT/BURST Immunity Test Configuration

FRONT VIEW



REAR VIEW

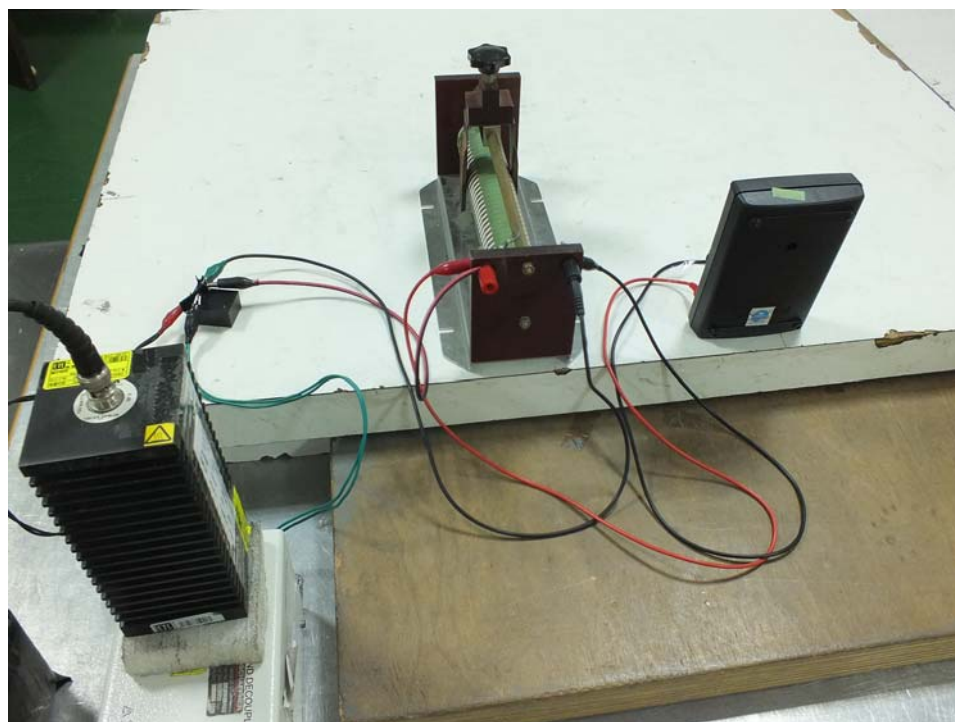


17.7. Photographs of CS Immunity Test Configuration

FRONT VIEW

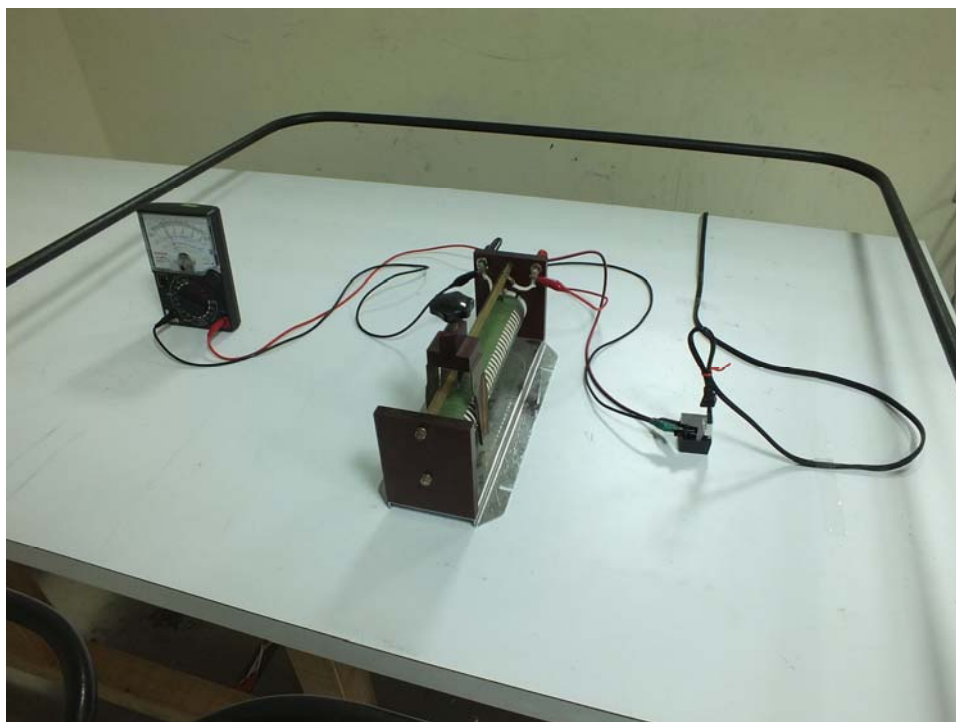


REAR VIEW

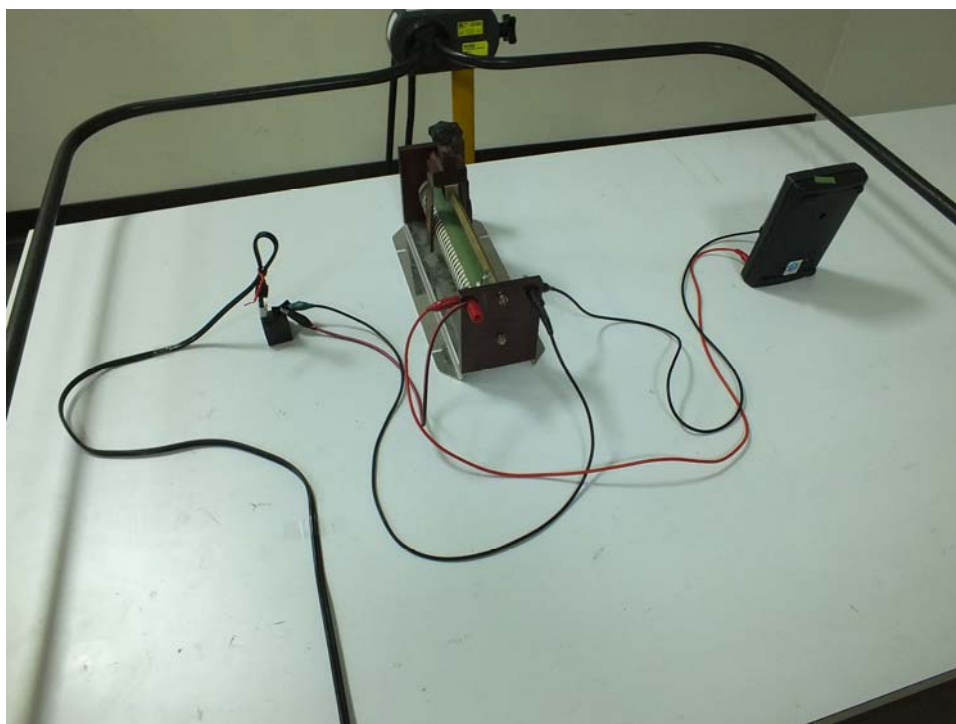


17.8. Photographs of PFMF immunity test Configuration

FRONT VIEW



REAR VIEW



18. List of Measuring Equipment Used

Conducted Emission

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Receiver	R&S	ESCS 30	100167	9 kHz - 2.75 GHz	Nov. 05, 2013	Conduction (CO01-NH)
LISN	SCHAFFNER	NNB41	06/10024	9kHz - 30MHz	Dec. 05, 2013	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	Dec. 11, 2013	Conduction (CO01-NH)

Note: Calibration Interval of instruments listed above is one year.

NCR: NO CALIBRATION REQUEST.

Radiation Emission Below 1GHz

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	Dec. 31, 2012	Radiation (OS02-NH)
Amplifier	BURGEON	BPA-530	100203	0.01 MHz - 3 GHz	Jun. 04, 2013	Radiation (OS02-NH)
Receiver	R&S	ESCI	100497	9 kHz - 3 GHz	Apr. 26, 2013	Radiation (OS02-NH)
Bilog Antenna	CHASE	CBL6122B	2884	30 MHz - 2 GHz	Feb. 10, 2013	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	Aug. 30, 2013	Radiation (OS02-NH)

Note: Calibration Interval of instruments listed above is one year.

NCR: NO CALIBRATION REQUEST.

EMS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
ESD Simulator	KEYTEK	MZ-15/EC	0711355	Air: 0 ~15kV Contact: 0 ~ 8kV	Apr. 15, 2013	ESD
Amplifier	AR	250W 1000AM	0332909	80MHz ~ 1GHz	Mar. 06, 2013	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC6180A	312453	0.08 ~ 1GHz	Oct. 07, 2013	RS
DUAL DIRECTIONAL COUPLER	AMPLIFIER& RESEARCH	DC7144A	312782	0.8 ~ 4.2GHz	Oct. 04, 2013	RS
INTEGRATED MEASUREMENT SYSTEM	ROHDE& SCHWARZ	IMS	100007	9kHz ~ 3GHz	Mar. 14, 2013	RS
NRP-Z91 POWER SENSOR 6GHZ	ROHDE& SCHWARZ	NRP-Z91 1168.8004.02	100095	9kHz ~ 3GHz	Mar. 14, 2013	RS
Antenna	FRANKONIA	BTA-L	02002L	26MHz ~ 1GHz	May 06, 2013	RS
Probe	ETS-LINDGREN	HI-6105	00086972	0.1MHz ~ 6GHz	Mar. 18, 2013	RS
EFT Generator	TESEQ	NSG3060	1452	0 ~ 4kV	Sep. 18, 2013	EFT
SURGE Generator	TESEQ	CDN 3061	1462	0 ~ 6 kV/2 Ω 0~ 6 kV/12 Ω	Sep. 18, 2013	SURGE
Conducted Immunity Test System	TESEQ	NSG4070	34293	9kHz ~ 1GHz	Jun. 26, 2013	CS
Attenuator	BIRD	100-SA-MFB-06	0232	150kHz ~ 230MHz	Jun. 15, 2013	CS
Coupling and Decoupling Network	SCHAFFNER	CDN M016	16672	150kHz ~ 230MHz	Jun. 29, 2013	CS
Magnetic field Immunity Loop	FCC (KEYTEK)	F-1000-4-8-G-125A	03007	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Oct. 14, 2013	Magnetic
Magnetic Generator	FCC (KEYTEK)	F-1000-4-8/9/10-L-1M	03003	30A//CONTINUOUS 100A/2Hrs 230A/30SEC	Oct. 14, 2013	Magnetic
DIP Generator	TESEQ	VAR 3005-S16	0793	230VA/50Hz/60Hz 0%Open/5S 0%Short/5S 40%0.10S 70%/0.01S	Sep. 18, 2013	DIP
Harmonic/Flicker Test System	SCHAFFNER	CCN1000-1	72471	4000VA 16A PEAK	Feb. 22, 2013	Harmonics, Flicker

Note: Calibration Interval of instruments listed above is one year.

19. Uncertainty of Test Site

Emission Test Measurement Uncertainty

Test Items	Test Site No.	Uncertainty	Remark
Conducted Emissions	CO01-NH	± 2.6dB	Confidence levels of 95%
Radiated Emissions below 1GHz	OS02-NH	± 3.0dB	Confidence levels of 95%

Immunity Test Measurement Uncertainty

◆ ESD Immunity (IEC 61000-4-2)

Negative Discharge Current

From Standard			
2kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	7.5	4	2
Min	6.75	2.8	1.4
Max	8.25	5.2	2.6
Tolerance in %	10%	30%	30%

From calibration certificate					
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%
7.48	7.85	4.2	4.41	2.01	2.11
	6.75		2.8		1.4
	8.25		5.2		2.6

From Standard			
4kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	15	8	4
Min	13.5	5.6	2.8
Max	16.5	10.4	5.2
Tolerance in %	10%	30%	30%

First Peak Current	1st Peak Worst case. +5%	Measured Current at 30ns	30ns Worst case. +5%	Measured Current at 60ns	60ns Worst case. +5%
15.12	15.88	8.03	8.43	3.68	3.86
	13.5		5.6		2.8
	16.5		10.4		5.2

From Standard			
6kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	22.5	12	6
Min	20.25	8.4	4.2
Max	24.75	15.6	7.8
Tolerance in %	10%	30%	30%

First Peak Current	1st Peak Worst case. -5%	Measured Current at 30ns	30ns Worst case. +5%	Measured Current at 60ns	60ns Worst case. +5%
22.78	23.92	12.37	12.99	5.45	5.72
	20.25		8.4		4.2
	24.75		15.6		7.8

Negative Discharge Current

From Standard			
8kV	First Peak Current	Current at 30ns	Current at 60ns
Nominal	30	16	8
Min	27	11.2	5.6
Max	33	20.8	10.4
Tolerance in %	10%	30%	30%

From calibration Certificate					
First Peak Current	1st Peak Worst case. +5%	Measured Current at 30ns	30ns Worst case. +5%	Measured Current at 60ns	60ns Worst case. +5%
30.26	31.77	16.13	16.94	7.39	7.76
	27		11.2		5.6
	33		20.8		10.4

Negative Discharge Voltage

Standard Parameters			
Indicated Voltage.	Tolerance.	Max.	Min.
kV	%	kV	kV
2	10	2.20	1.80
4	10	4.40	3.60
6	10	6.60	5.40
8	10	8.80	7.20
15	10	16.50	13.50

Measured Values
kV
2.05
4.027
5.955
7.916
14.839

Negative Rise Time

Standard Parameters	
T max.	1ns
T min	0.7ns

Measured Values			
Indicated Voltage.	Measured Rise Time.	Worst Case max. +6%	Worst Case min. -6%
2kV	0.851	0.902	0.799
4kV	0.780	0.827	0.733
6kV	0.750	0.795	0.705
8kV	0.772	0.818	0.726

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)

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$u_i(y)$
F_{SM}	Felds Strength monitor	1.5	Normal 2	2.000	0.75
FS_{AW}	Field Strength acceptability window	0.50	Rectangular	1.732	0.29
PAH	Power Amplifier Harmonics	0.50	Rectangular	1.732	0.29
R_S	Measurement System Repeatability	0.50	normal 1	1.000	0.50
R_{EUT}	Repeatability of EUT	0.00	normal 1	1.000	0.00
$u_c(F_S)$	Combined Standard Uncertainty	-	normal	-	0.83
$U(F_S)$	Expanded Uncertainty	-	normal k= 2		1.66

Specified Level (V/m)	Test level (V/m)
For 1 Volts	1.25
For 3 Volts	3.33
For 10 Volts	11.22

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

Symbol	Source of Uncertainty	Value	Probability distribution	Divisor	$u_i(y)$
S_A	Spectrum Analyzer	1.50	Rectangular	1.732	0.87
C_C	Current coil Calibration	1.00	normal 2	2.000	0.50
M	Mismatch	-0.5	U-shaped	1.414	-0.35
M	Mismatch	-0.3	U-shaped	1.414	-0.35
R_S	Measurement System Repeatability	0.50	normal 1	1.000	0.50
R_{EUT}	Repeatability of EUT	0.00	normal 1	1.000	0.00
$u_c(F_S)$	Combined Standard Uncertainty	-	normal	-	1.57
$U(F_S)$	Expanded Uncertainty	-	normal k= 2		3.14

Specified Level (V)	Test level (V)
For 1 Volts	1.30
For 3 Volts	3.88
For 10 Volts	12.15

APPENDIX A. Photographs of EUT

