SK TECH CO., LTD.

Certificate of Compliance

Test Report No.:	**SKTTRT-050411-006**		
NVLAP CODE:	**200220-0**		
Applicant:	**SPACESENSING CO., LTD.**		
Applicant Address:	B109, Business Incubating Center, San65, Bokjung-Dong, Soojung-Gu, Sungnam, Kyunggi-Do, Korea, 461-701		
Device Under Test:	**Space Sensing Multi-Functional Wireless Mouse**		
FCC ID:	**STLSW-T100**	**Model No.:**	**SW-T100**
Receipt No.:	SKTEU05-0232	**Date of receipt:**	April 08, 2005
Date of Issue:	April 11, 2005		
Location of Testing:	**SK TECH CO., LTD.** 820-2, Wolmoon-Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea		
Test Procedure:	**ANSI C63.4**		
Test Specification:	**47CFR, Part 15 Rules**		
Equipment Class:	**DXX - Part 15 Low Power Communication Device Transmitter**		
Test Result:	The above-mentioned device has been tested and passed.		

Tested & Reported by: *Jong-Soo, Yoon*

2005.04.11

Signature *Date*

Approved by: *Jae-Kyung, Bae*

2005.04.11

Signature *Date*

Other Aspects:	**-**
Abbreviations:	**· OK, Pass = passed · Fail = failed · N/A = not applicable**

NVLAP®

NVLAP Lab. Code: 200220-0

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1. GENERAL

These tests were performed using the test procedure outlined in ANSI C63.4, 2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.249 for Low Power Communication Device Transmitter. The EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards.

We attest to the accuracy of data. All measurements reported herein were performed by SK Tech Co., Ltd. and were made under Chief Engineer's supervision.
We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. TEST SITE

SK TECH Co., Ltd.

2.1 Location

820-2, Wolmoon Ri, Wabu-Up, Namyangju-Si, Kyunggi-Do, Korea

This test site is in compliance with ISO/IEC 17025 for general requirements for the competence of testing and calibration laboratories.
This laboratory is accredited by NVLAP for NVLAP Lab. Code: 200220-0 and DATech for DAR-Registration No.: TTI-P-G155/97-10

2.2 List of Test and Measurement Instruments

Description	Manufacturer	Model #	Serial #	
Spectrum Analyzer	Agilent	E4405B	US40520856	
EMC Spectrum Analyzer	Agilent	E7405A	US40240203	☒
EMI Test Receiver	Rohde&Schwarz	ESVS10	825120/013	☒
EMI Test Receiver	Rohde&Schwarz	ESVS10	834468/008	☒
EMI Test Receiver	Rohde&Schwarz	ESHS10	825120/013	☒
EMI Test Receiver	Rohde&Schwarz	ESHS10	834468/008	☒
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	836679/018	☒
Pre-amplifier	HP	8447F	3113A05153	☒
Pre-amplifier	HP	8349B	2644A03250	☒
Power Meter	Agilent	E4418B	3318A13916	
Power Sensor	HP	8485A	3318A13916	
VHF Precision Dipole Antenna (TX & RX)	Schwarzbeck	VHAP	1014 & 1015	
UHF Precision Dipole Antenna (TX & RX)	Schwarzbeck	UHAP	989 & 990	
Loop Antenna	Schwarzbeck	HFH2-Z2	863048/019	
TRILOG Broadband Antenna	Schwarzbeck	VULB9160	3141	☒
Biconical Antenna	Schwarzbeck	VHA9103	2265	☒
Log-Periodic Antenna	Schwarzbeck	UHALP9107	1819	☒
Horn Antenna	AH Systems	SAS-200/571	304	☒
Horn Antenna (TX & RX)	Electro Metrics	EM-6961	6297 & 6298	
Vector Signal Generator	Agilent	E4438C	MY42080359	
Signal Generator	HP	8349B	2644A03250	
DC Power Supply	HP	6634A	2926A-01078	
DC Power Supply	HP	6268B	2542A-07856	
Digital Multimeter	HP	HP3458A	2328A14389	
PCS Interface	HP	83236B	3711J00881	
CDMA Mobile Test Set	HP	8924C	US35360253	
Hygro/Thermo Graph	SATO	PC-5000TRH-II	-	☒
Temperature/Humidity Chamber	All Three	ATH-50M	20030425	

2.3 Test Date

Date of Application : April 08, 2005

Date of Test : April 08, 2005 ~ April 09, 2005

2.4 Test Environment

See each test item's description.

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

The EUT is a wireless mouse equipped with 2.4GHz RF transmitter. The product specification described herein was obtained from the product data sheet or user's manual.

3.1 Rating and Physical Characteristics

Type / Model No.	Space Sensing Multi-Functional Wireless Mouse / SW-T100
Power source	DC 2.4V (AAA Li-MH battery × 2)
Local Oscillator or X-Tal	X-Tal: 18.43 MHz, 16 MHz
Transmit Frequency	2402 MHz (fixed)
Antenna Type	Integral (SMD Chip Ant., Model: AHD1403-244ST10, 50Ω, Max. 1.34dBi)
Type of Modulation	GFSK
RF Output power	< 0 dBmW
External Ports	- DC Charging Terminal Charging Cradle Manufacturer: SPACESENSING CO., LTD. Model: SW-C100 Input: DC 5V fed via USB port

3.2 Equipment Modifications

None

3.3 Submitted Documents

Block diagram

Schematic diagram

Part List

User manual

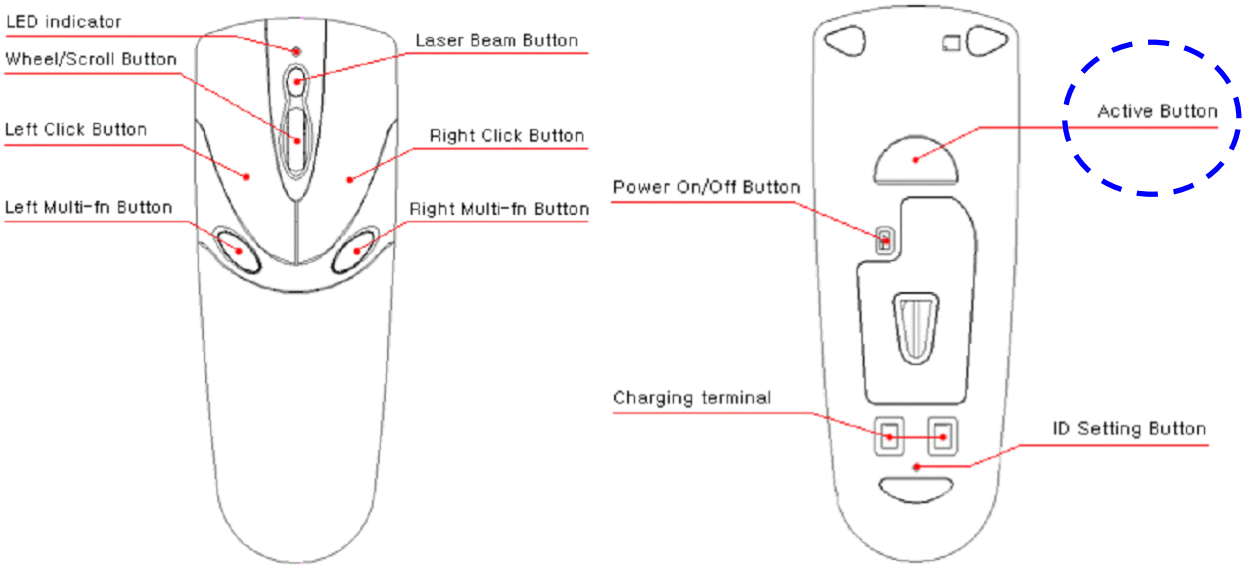
Antenna Specification

RF module specification

4. MEASUREMENT CONDITIONS

4.1 Description of test configuration

The measurements were taken in continuous transmitting mode – Active button on the EUT was pressed.



4.2 List of Peripherals

Equipment Type	Manufacture	Model	Cable Description
Notebook PC	LG IBM	2681-LK6	-
AC Adaptor	Astec Electronics Co., Ltd.	08K8202	1.5m, Unshielded power line
Charging Cradle	SPACESENSING CO., LTD.	SW-C100	0.9m, Unshielded line (USB)
RF Receiver	SPACESENSING CO., LTD.	SW-R120	FCC ID: STLSW-R120

** For measurements of Conducted Spurious Emissions during charging the rechargeable battery.

4.3 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Conducted RF power	± 1.49 dB	±2.98dB
Radiated disturbance	± 2.37 dB	±4.74dB
Conducted disturbance	± 1.47 dB	±2.94dB

5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	CFR 47 Section	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
Radiated Emissions	15.249(a)&(d), 15.209(a)	5.2	PASS
Conducted Emissions	15.207(a)	5.3	PASS

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.1.2 Result: PASS

The EUT uses an integral SMD chip antenna, Model: AHD1403-244ST10, 50Ω, Max. 1.34dBi

☒ The EUT uses a permanently connected antenna

☐ The antenna is affixed to the EUT using a unique connector which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector

☐ The EUT requires professional installation (attach supporting documentation if using this option)

5.2 RADIATED EMISSIONS

5.2.1 Regulation

According to §15.249(a), the filed strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of Fundamental (mV/m @ 3m)	Field strength of Fundamental (dBuV/m @ 3m)	Field strength of Harmonics (uV/m @ 3m)	Field strength of Harmonics (dBuV/m @ 3m)
902 – 928	50	94	500	54
2400 – 2483.5	50	94	500	54
5725 – 5875	50	94	500	54
24000 – 24250	250	108	2500	68

According to §15.249(d), emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to §15.109(a), for Class B digital devices, the field strength of radiated emissions has the same limits specified in §15.209(a).

Frequency (MHz)	Field strength (uV/m @ 3m)	Field strength (dBuV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

The emission limits shown in the above tables are based on measurement instrumentation employing a CISPR quasi-peak detector below 1000 MHz and an average detector above 1000 MHz. However, the peak field strength of any emission shall not exceed the average limit by more than 20 dB.

5.2.2 Test Procedure

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.

5.2.3 Test Results: PASS

Table 1: Measured values of the Field strength of spurious emission

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Antenna Height [m]	Table Angle [°]	Reading [dB(μV)]	Amp Gain [dB]	AF / CL [dB(1/m)]	Actual [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Emissions in 15.249 (a) – Fundamental										
PEAK										
2402.0	1000	V	1.79	190	84.01	30.1	29.2/7.4	90.51	114.0	23.49
AVERAGE										
2402.0	1000	V	1.79	190	75.17	30.1	29.2/7.4	81.67	94.0	12.33
Emissions in 15.249 (a), 15.249 (d) and 15.209 (a) – Spurious										
PEAK										
2360.5	1000	V	1.79	190	56.10	30.1	29.2/7.4	62.60	74.0	11.40
2388.0	1000	V	1.79	190	55.48	30.1	29.2/7.4	61.98	74.0	12.02
2400.0	1000	V	1.79	190	61.15	30.1	29.2/7.4	67.65	74.0	6.35
2483.5	1000	V	1.79	190	46.53	30.1	29.2/7.4	53.03	74.0	20.97

AVERAGE										
2360.5	1000	V	1.79	190	30.30	30.1	29.2/7.4	36.80	54.0	17.20
2388.0	1000	V	1.79	190	29.78	30.1	29.2/7.4	36.28	54.0	17.72
2400.0	1000	V	1.79	190	32.74	30.1	29.2/7.4	39.24	54.0	14.76
2483.5	1000	V	1.79	190	27.63	30.1	29.2/7.4	34.13	54.0	19.87

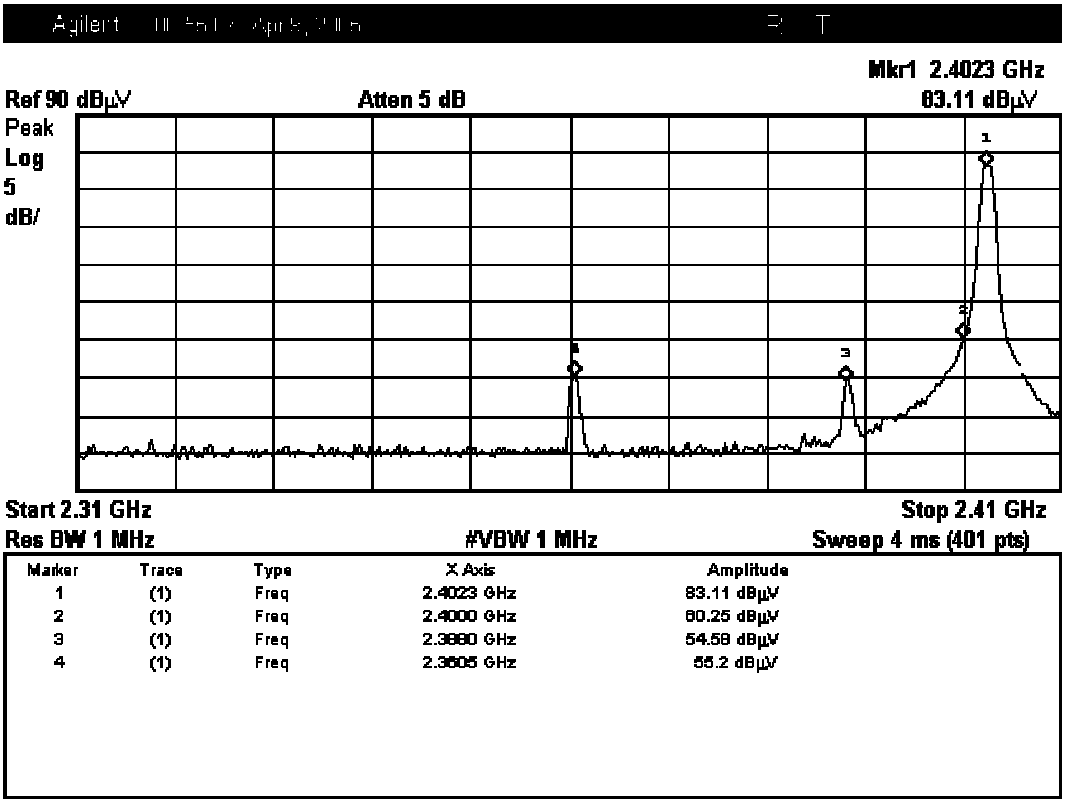
QUASI-PEAK										

Margin (dB) = Limit – Actual
[Actual = Reading – Amp Gain + AF + CL]
1. H = Horizontal, V = Vertical Polarization
2. AF/CL = Antenna Factor and Cable Loss
Remark "---" means the emission level was too low to be measured or in the noise floor.

NOTE: The spectrum was scanned from 30 MHz to 18 GHz. All emissions not reported were more than 20 dB below the specified limit or in the noise floor. The measured data in the above table include the spurious radiated emissions that do not fall in the restricted bands.

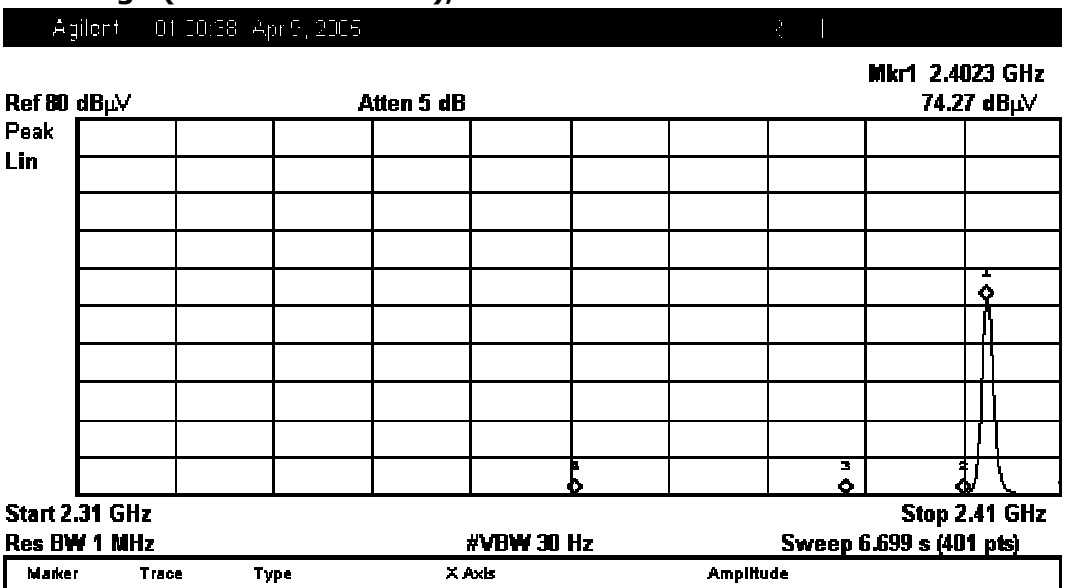
Figure 1. Plot of the Band Edge

Low band edge (2310 - 2390 MHz), PEAK



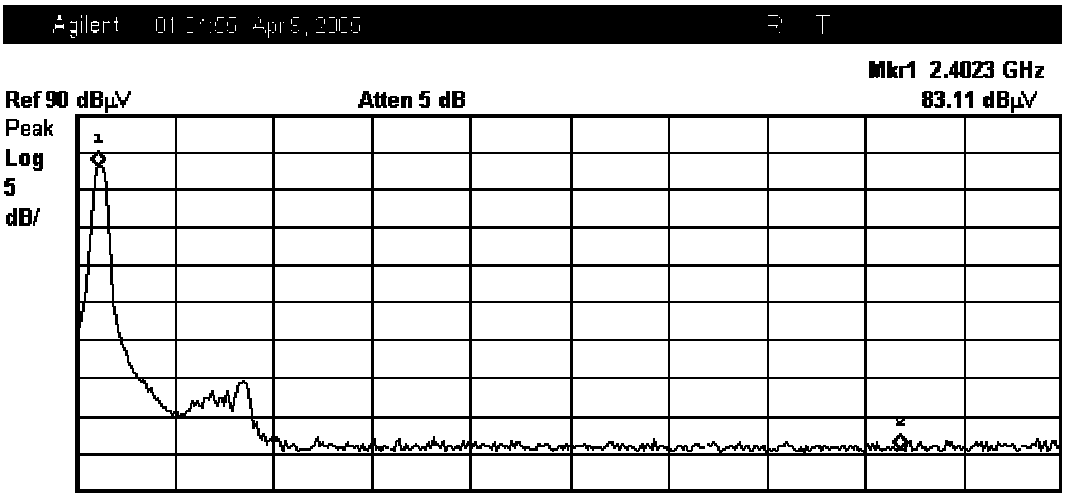
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4023 GHz	83.11 dBµV
2	(1)	Freq	2.4000 GHz	80.25 dBµV
3	(1)	Freq	2.3880 GHz	54.58 dBµV
4	(1)	Freq	2.3605 GHz	55.2 dBµV

Low band edge (2310 - 2390 MHz), AVERAGE



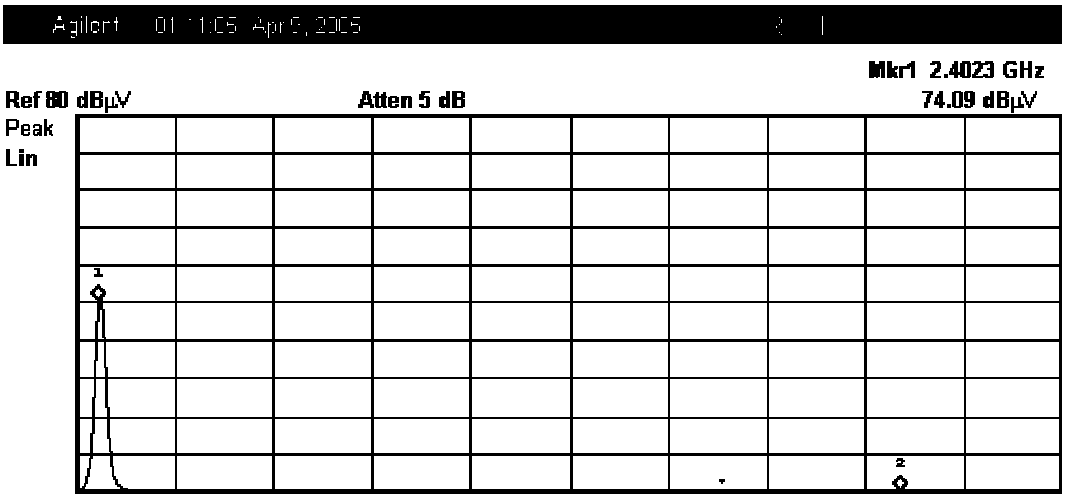
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4023 GHz	74.27 dBµV
2	(1)	Freq	2.4000 GHz	31.84 dBµV
3	(1)	Freq	2.3880 GHz	28.88 dBµV
4	(1)	Freq	2.3605 GHz	29.4 dBµV

High band edge (2483.5 - 2500MHz), PEAK



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4023 GHz	83.11 dBµV
2	(1)	Freq	2.4836 GHz	46.63 dBµV

High band edge (2483.5 - 2500MHz), AVERAGE



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.4023 GHz	74.09 dBµV
2	(1)	Freq	2.4836 GHz	26.73 dBµV

5.3 CONDUCTED EMISSIONS

5.3.1 Regulation

According to §15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.3.2 Test Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

5.3.3 Test Results: PASS

Table 2: Measured values of the Conducted Emissions

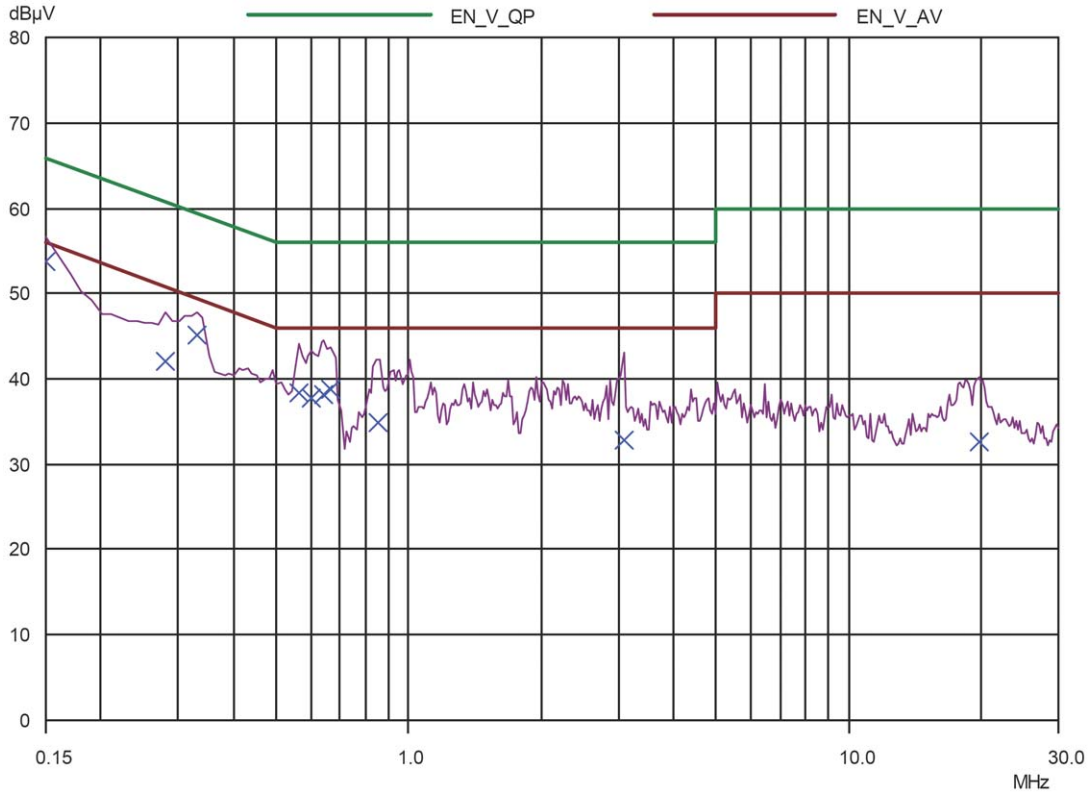
Frequency [MHz]	Reading [dBμV]		CF/CL [dB]	Actual [dBμV]		Limit [dBμV]		Margin [dB]	
	Qp	Ave		Qp	Ave	Qp	Ave	Qp	Ave
LINE – PE									
0.15	53.77	---	0.09/0.1	53.96	---	66.00	56.00	12.04	---
0.28	42.12	---	0.09/0.1	42.31	---	60.82	50.82	18.51	---
0.33	45.07	---	0.09/0.1	45.26	---	59.45	49.45	14.19	---
0.56	38.40	---	0.13/0.1	38.63	---	56.00	46.00	17.37	---
0.60	37.83	---	0.13/0.1	38.06	---	56.00	46.00	17.94	---
0.64	38.10	---	0.13/0.1	38.33	---	56.00	46.00	17.67	---
0.66	38.75	---	0.13/0.1	38.98	---	56.00	46.00	17.02	---
0.85	34.88	---	0.13/0.1	35.11	---	56.00	46.00	20.89	---
3.08	32.76	---	0.23/0.4	33.39	---	56.00	46.00	22.61	---
19.71	32.61	---	0.81/0.6	34.02	---	60.00	50.00	25.98	---
NEUTRAL – PE									
0.15	53.22	---	0.13/0.1	53.45		66.00	56.00	12.55	---
1.11	38.81	---	0.15/0.1	39.06		56.00	46.00	16.94	---
2.92	40.63	---	0.24/0.4	41.27		56.00	46.00	14.73	---
2.98	41.68	---	0.24/0.4	42.32		56.00	46.00	13.68	---
3.05	42.22	---	0.24/0.4	42.86		56.00	46.00	13.14	---
3.12	41.71	---	0.24/0.4	42.35		56.00	46.00	13.65	---
3.15	39.40	---	0.24/0.4	40.04		56.00	46.00	15.96	---
3.19	40.11	---	0.24/0.4	40.75		56.00	46.00	15.25	---
3.66	33.03	---	0.24/0.4	33.67		56.00	46.00	22.33	---
19.31	36.93	---	0.60/0.6	38.13		60.00	50.00	21.87	---

Margin (dB) = Limit – Actual
[Actual = Reading + CF + CL]
1. Remark "---" means the level is undetectable or the Qausi-peak value is lower than the limit of Average.
2. CF/CL = Correction Factor and Cable Loss
3. Qp = Quasi-peak, Ave = Average value

NOTE: The frequency range was scanned from 150 kHz to 30 MHz. All emissions not reported were more than 20 dB below the specified limit.

Figure 2. Plot of the Conducted Emissions

Line – PE (Quasi-Peak reading)



Neutral – PE (Quasi-Peak reading)