

Electromagnetic Emission

F C C M E A S U R E M E N T R E P O R T

According to the FCC Rule Part 15 Subpart B

Product : OPTICAL MOUSE

Model : E SENS M5

Serial Number : Prototype

FCC ID : PK7ESEN-M5

Prepared for :

JS Trading Co., Ltd.

**Rm.405, San-da Bldg.,
#97, Da-dong, Chung-ku, Seoul, Korea**

Prepared by:

Report Date : April 16, 2001

E-RAE Testing Laboratory Inc.

**371-51, Gasan-Dong, Geumcheon-Gu,
Seoul, 153-023, Korea**

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FCC MEASUREMENT REPORT

Scope – Measurement and determination of electromagnetic emission(EME) of radio frequency devices including intentional radiators and/or unintentional radiators for compliance with the technical rules and regulations of the U.S Federal Communications Commission(FCC)

Applicant Name : JS Trading Co.,Ltd.
Address : Rm.405, San-da Bldg., #97, Da-dong,
Chung-ku, Seoul, Korea
Attention : David Kim

EUT Type : Optical Mouse
Model Number : E SENS M5
Trade Name : ESENS
Buttons : 5 buttons + 1 wheel
FCC Rule Part(s) : FCC Part 15 Subpart B Class B
FCC Procedure : Certification
Dates of Tests : April 14, 2001
Place of Tests : E-Rae Testing Lab.
EMI Test Site
584, Sangwhal-Ri, Kanam-Myun, Yoju-Kun,
Kyeonggi-Do, Korea
Tel : (031) 885-0072 Fax : (031) 885-0074
Test Report No. : E01.0414.FCC15B.155.N

SUMMARY

This equipment was tested in accordance with the measurement procedures specified in **ANSI C63.4-1992**. The equipment fulfill the technical requirements of section15.107 &15.109 class B and complies with the general approval requirements set forth in the regulation of FCC Part 15 Subpart B of CFR 47.

Prepared by : *Yo Han, Park*

Reviewed by : *Kayoung Kim*

Name Yo Han, Park
Title Test Engineer

Name Kayoung Kim
Title Chief Engineer / EMC Lab.

1. Introduction

The measurement test for radiated and conducted emission test were conducted at the shielded chamber and open area test site of E-RAE Testing Laboratory Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyongki-do, Korea. The site is constructed in conformance with the requirements of the ANSI C63.4-1992 and CISPR Publication 22. ETL has site descriptions on file with the FCC for 3 and 10 meter site configurations. Detailed description of test facility was found to be in compliance with the requirements of Section 2.948 FCC Rules according to the ANSI C63.4-1992 and registered to the Federal Communications Commission(Registration Number : 95422).

The measurement procedure described in American National Standard for Method of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C.63.4-1992) was used in determining radiated and conducted emissions from the **JS Trading Co.,Ltd. Model : E SENS M5.**

2. Product Information

2.1 Equipment Description

The Equipment Under Test(EUT) Model : E SENS M5 by the JS Trading Co.,Ltd. is the multifunctional 5 button optical mouse with no mouse ball.

2.2 General Specification

- Chassis Type	PLASTIC
- List of Each OSC. Or X-Tal. Freq.($\geq$ 1MHz)	18.432 MHz
- Feature and Spec.	Size : 67 X 120 X 47 mm (W/H/D) Weight : 75g Cable length : 180 cm Switches : Characterized Switches
- Connector Type	PS/2

2.3 EMI Suppression Device(s)

The equipment is not modified anything, mechanical or circuits to improve EMI status during a measurement. No EMI suppression device(s) was added and/or modified during testing.

3. Description of Tests

3.1 AC Line Conducted Emission Test

Conducted emissions measurements were made in accordance with section 11, "Measurement of Information Technology Equipment" of ANSI C63.4-1992. The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50 Ω /50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity Meter. The measurements were made with the detector set for "Peak" amplitude within an bandwidth of 10KHz or for "quasi-peak" within a bandwidth of 9KHz.

The line-conducted emission test is conducted inside a shielded anechoic chamber room with 1m x 1.5m x 0.8m wooden table which is placed 40cm away from the vertical wall and 1.5m away from the side wall of the chamber room. The two EMCO 3825/2 LISNs are bonded to the shielded room. The EUT is powered from the EMCO LISN and the support equipment is powered from another EMCO LISN. Power to the LISNs is filtered by a noise cut power line filters. All electrical cables are shielded by braided tinned steel tubing with inner ϕ 1.2cm. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and these supply lines will be connected to the EMCO LISN. All interconnecting cables more than 1m were shortened by non-inductive bundling(serpentine fashion) to a 1m length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the R3261A Spectrum Analyzer to determine the frequency producing the max. emission from the EUT. The frequency producing the max. level was reexamined using the detector function set to the CISPR Quasi-Peak mode by manual, after scanned by automatic Peak mode from 0.45 to 30MHz. The bandwidth of the Spectrum Analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by switching power lines, varying the mode of operation or resolution, clock or data exchange speed, if applicable, whichever determined the worst-case emission. Each emission reported was calibrated using self-calibrating mode. Photographs of the worst-case emission can be seen in photographs of conducted emission test setup.

3.2 Radiated Emission Test

Preliminary measurements were made at indoors 3 meter semi EMC Anechoic Chamber using broadband antennas, broadband amplifier, and spectrum analyzer to determine the emission frequencies producing the maximum EME.

Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 1000MHz using Logbicon antenna(VULB9165) and above 1000MHz, linearly polarized double ridge horn antennas were used. Above 1GHz, linearly polarized double ridge horn antennas were used. Emission level from the EUT with various configurations were examined on the spectrum analyzer connected with the RF amplifier and plotted graphically.

Final measurements were made outdoors open site at 3-meter test range using TriLog antenna(VULB9160). The output from the antenna was connected, via a preselector or a preamplifier, to the input of the EMI Measuring Receiver and Spectrum analyzer(for above 1GHz). The detector function was set to the quasi-peak or peak mode as appropriate. The measurement bandwidth on the Field strength receiver was set to at least 120kHz (1MHz for measurement above 1GHz), with all post-detector filtering no less than 10 times the measurement bandwidth.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during preliminary measurement was examined and investigated as the same set up and configuration which produced the maximum emission level.

The EUT, support equipment and interconnecting cables were configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1m x 1.5 meter table. The turntable containing the system was rotated and the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission.

Each emission was maximized by varying the mode of operating modes of the EUT. The worst case emissions are recorded in the data tables. If necessary, the radiated emission measurement could be performed at a closer distance to ensure higher accuracy and the results were extrapolated to the specified distance using an inverse linear distance extrapolation factor(20Db/decade) as per section 15.31(f).

Photographs of the worst-case emission test setup can be seen in Appendix B.

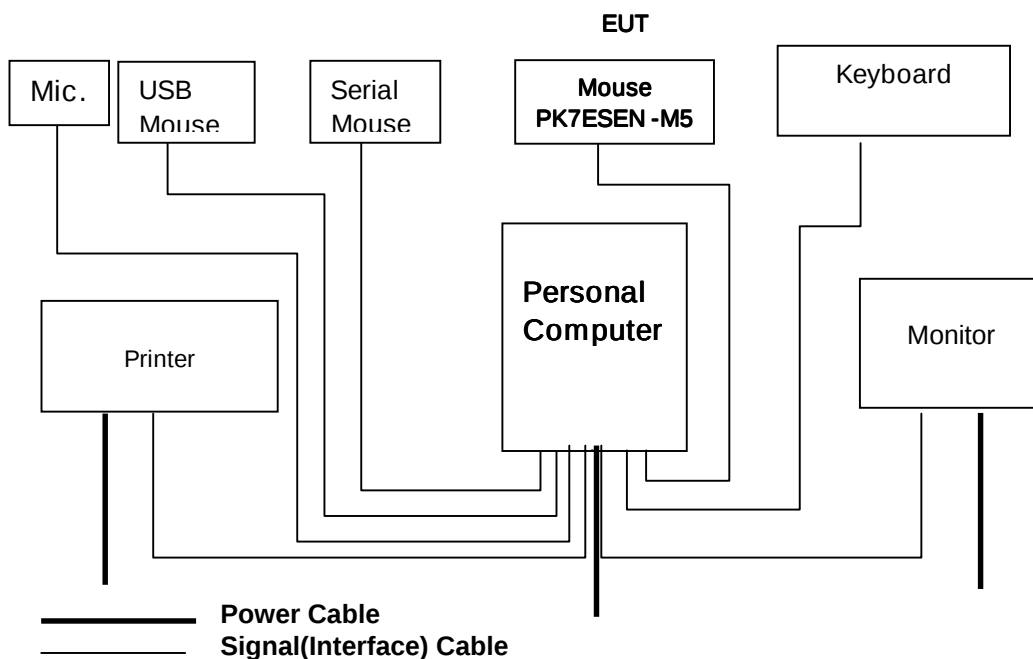
4. System Test Configuration

4.1 Configuration of Tests

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following conditions and configurations were used.

EUT was connected to LISN, all other supporting equipment were connected to another LISN. Preliminary power line conducted emission tests were performed by using the procedure in ANSI C63.4/1992 Clause 7.2.3 to determine the worst operating conditions.

Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/1992 Clause 8.3.1.1 to determine the worst operating condition. Final radiated emission tests were conducted at 10 meter open field test site.



4.2 EUT exercise equipment

The EUT exercise equipment used during the radiated and conducted testing was designated to exercise the various system components in a manner similar to a typical use.

4.3 Tested System Details

Following peripheral devices and interface cables were connected during the measurement:

EUT : Optical Mouse

FCC ID : PK7ESEN-M5
Model Name : E SENS M5
Serial No. : N/A
Manufacturer : JS Trading Co., Ltd.
Power Cord : N/A
Data Cable : Non-shielded 1.8m

Support Unit 1 - Personal computer (DELL)

FCC ID : N/A (DoC)
Model Name : MMP
Serial No. : 2LL11S
Manufacturer : DELL
Power Supply Type : Switching
Power Cord : Non-Shielded, Detachable, 1.2m
Port : Parra: 1, USB: 2, Keyboard: 1, Mouse: 1, RS-232: 2

Support Unit 2 – Monitor (E-RAE)

FCC ID : OIOELM-150
Model Name : ELM-150A
Serial No. : N/A
Manufacturer : E-RAE Electronics Industry Co., Ltd.
PowerSupply Type : DC 12V From Adaptor(APIOAD42 / ACBEL POLYTECH INC.)
Power Cord : Non-Shielded, Detachable, 1.2m
Data Cable : Shielded 15pin D-sub, 1.5m

Support Unit 3- Keyboard (DELL)

FCC ID : N/A(DOC)
Model Name : SK-8000
Serial No. : 2965
Manufacturer : DELL
Power Supply Type : N/A
Power Cord : N/A
Data Cable : Shielded, 1.2m

Support Unit 4 – Printer (H.P)

FCC ID : B94C2164X
Model Name : C4562B
Serial No. : TH9411434G
Manufacturer : H.P
Power Supply Type : DC24V From Adapter (C2182A/H.P)
Power Cord : Non-Shielded
Data Cable : Shielded, 1.5m

Support Unit 5 – USB Mouse (N/A)

FCC ID : N/A
Model Name : HL898W
Serial No. : HL08011837
Manufacturer : N/A
Power Supply Type : N/A
Power Cord : N/A
Data Cable : Shielded, 1.2m

Support Unit 6 – Serial Mouse (PETRA)

FCC ID : JKGMUS5S01
Model Name : MUS5S
Serial No. : E183027
Manufacturer : PETRA
PowerSupply Type : N/A
Power Cord : N/A
Data Cable : Un-Shielded, 1.2m

Support Unit 7 – MIC(ETL)

FCC ID : N/A
Model Name : N/A
Serial No. : N/A
Manufacturer : ETL
Power Supply Type : N/A
Power Cord : N/A
Data Cable : Shielded, 1.5m

4.4 Preliminary Tests Condition

During Preliminary Tests, the following operating mode was investigated.

Operating Mode	The worst operating condition
Stand by	
Test program play(DOS-Mode)	O

5. Conducted Emissions Test Results

EUT	Optical Mouse Model : E SENS M5 (SN:Prototype)
Limit apply to	FCC Part 15 Sbbpart B Class B Section 15.107 / CISPR 22 Class B
Test Date	April 14 , 2001
Applicant	JS Trading Co.,Ltd.
Operation Condition	Test program play(DOS-Mode)
	Humidity Level : 42 %RH, Temperature : 21
Result	Passed by – 12.55dB

Conducted Emission Test Data

The following table shows the highest levels of conducted emissions on both polarization of live and neutral line.

Detector mode : CISPR Quasi-Peak mode (6dB Bandwidth : 9 KHz)

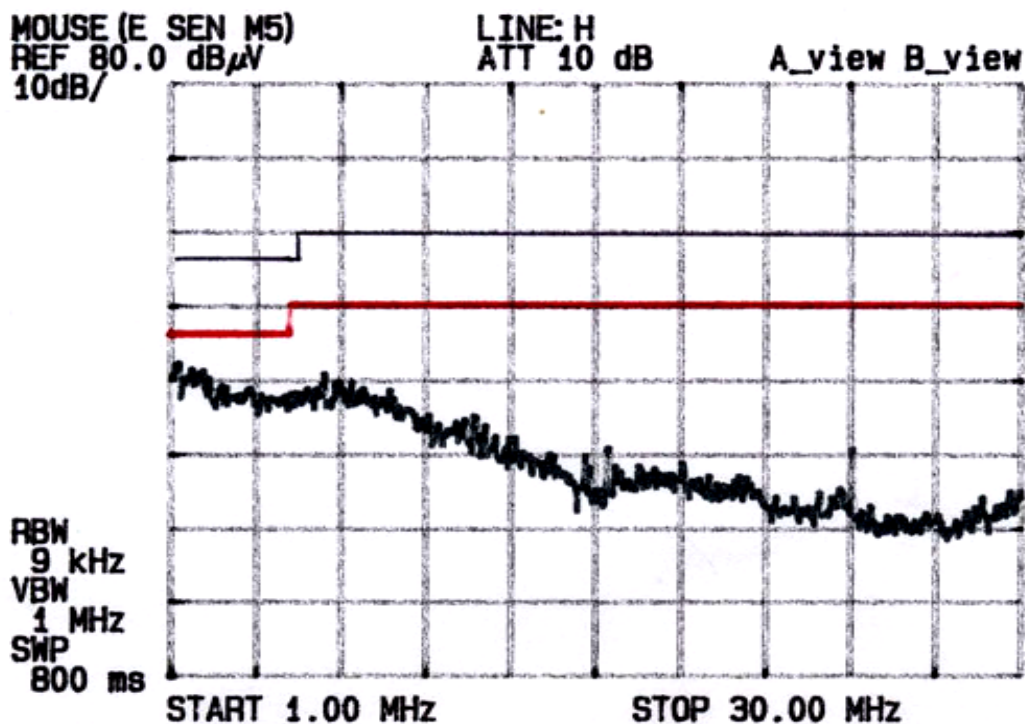
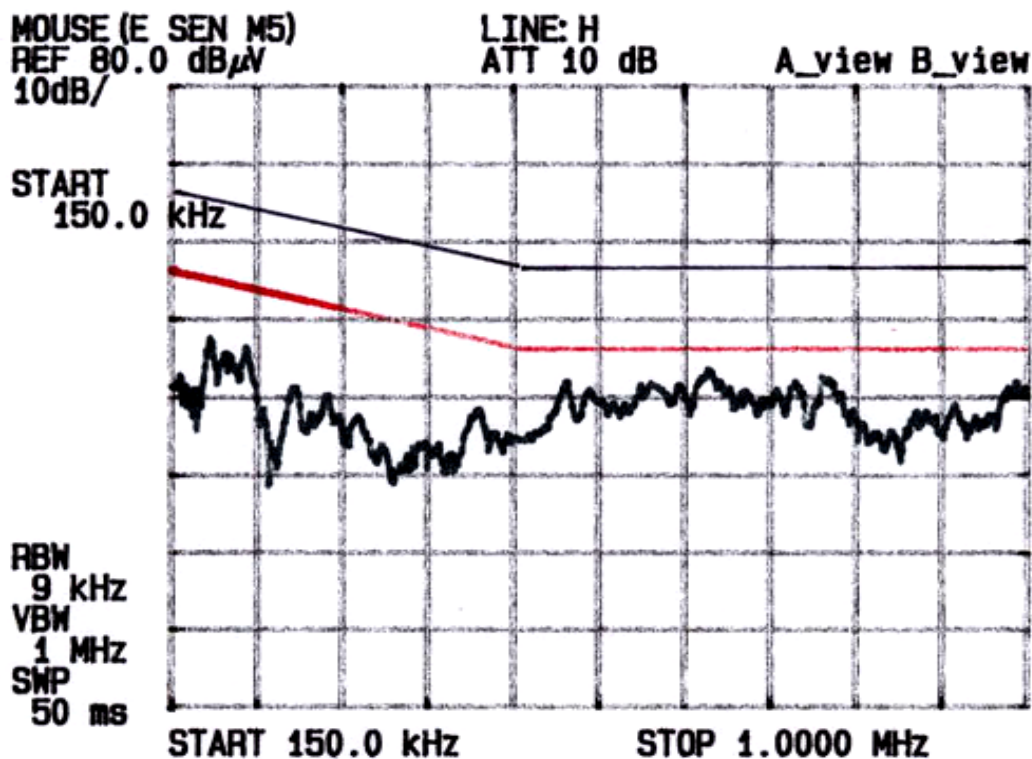
Frequency [MHz]	Reading [dBμV]		Phase (*H/**N)	Limit [dBμV]		Margin [dB]	
	Quasi-peak	Average		Quasi-peak	Average	Q.Peak	Average
0.188	47.90		H	64.12		16.22	
0.214	46.89		H	63.05		16.16	
0.273	41.35		H	61.03		19.68	
0.538	41.42		H	56.0		14.58	
0.684	43.75		H	56.0		12.25	
0.805	42.02		N	56.0		13.98	
1.125	41.62		N	56.0		14.38	
2.214	41.50		N	56.0		14.50	
4.690	40.35		N	56.0		15.65	
6.186	40.62		H	60.0		19.38	
8.427	38.55		H	60.0		21.45	
15.83	30.75		H	60.0		29.25	
24.16	30.70		H	60.0		19.30	

NOTE :
 * H: Hot Line , ** N: Neutral Line
 * Margin = Limit - Reading
 * If the Reading Quasi-Peak value is bellow the Average Limit, Do not test Average Mode.
 * All conditions were investigated and the worst-case emissions are reported.

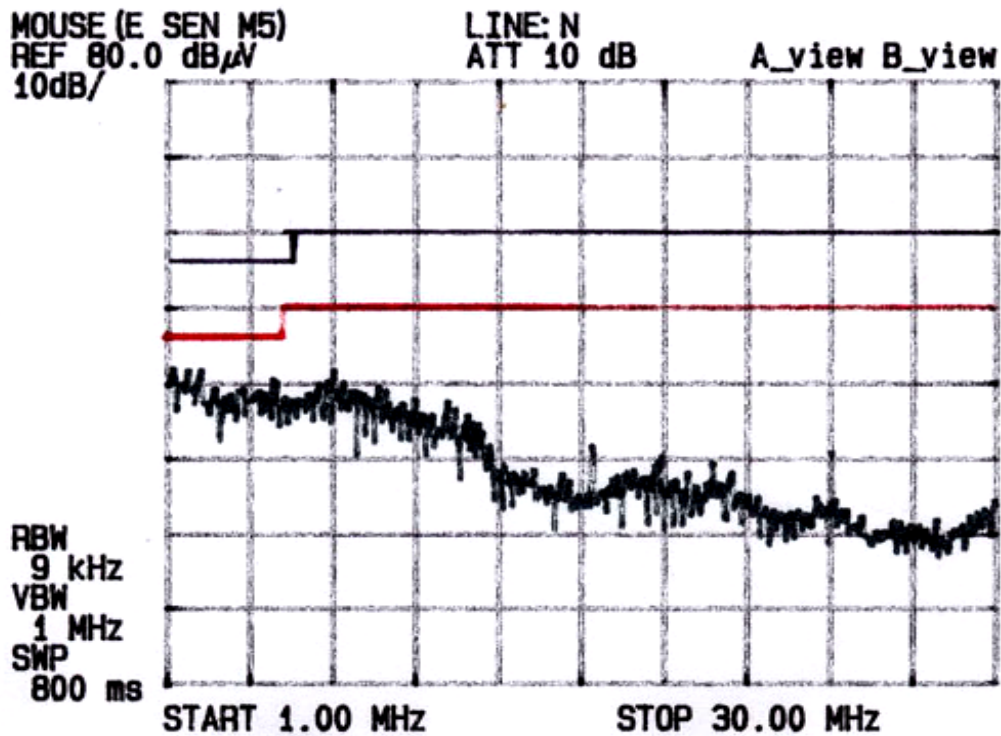
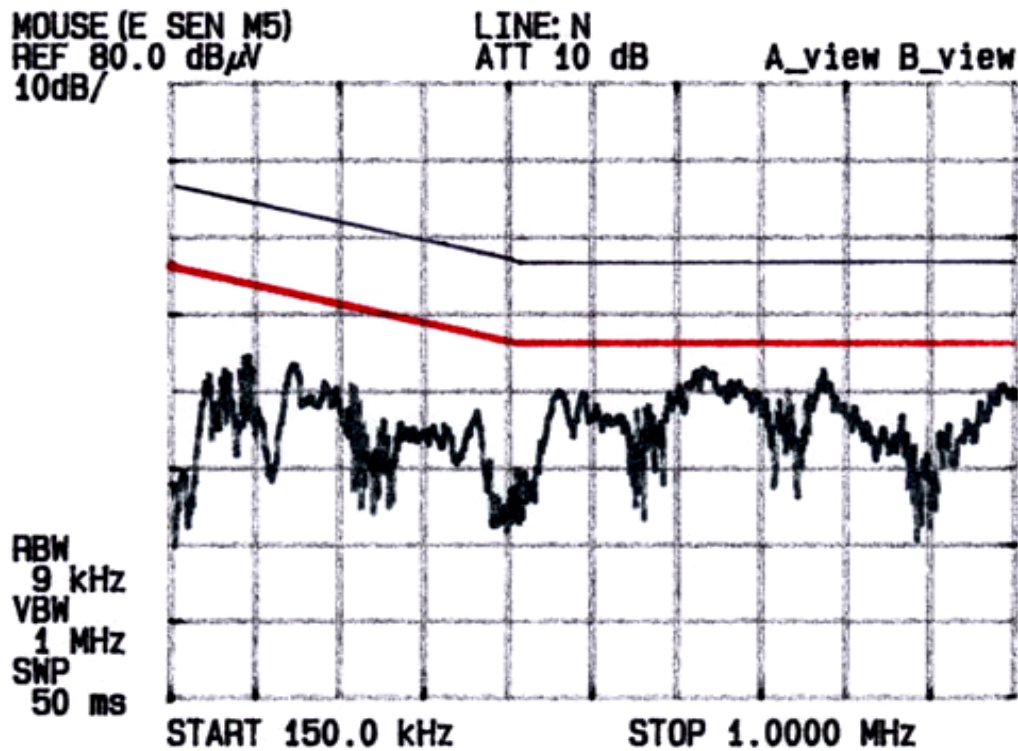
Yo Han, Park

Tested by : Yo Han, Park / Test Engineer

Line Polarization : Hot



Line Polarization : Neutral



6. Radiated Emissions Test Results

EUT	Optical Mouse Model : E SENS M5 (SN:Prototype)
Limit apply to	FCC Part 15 Sbbart B Class B Section 15.109 / CISPR 22 Class B
Test Date	April 14 , 2001
Applicant	JS Trading Co.,Ltd.
Operation Condition	Test program play(DOS-Mode)
	Humidity Level : 42 %RH, Temperature : 21
Result	Passed by – 4.02dB

Radiated Emission Test Data

The following table shows the highest levels of radiated emissions on both horizontal and vertical Polarization.

Detector mode : CISPR Quasi-Peak mode (6dB Bandwidth : 120 kHz)

Frequency [MHz]	Reading [dB μ V]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Result [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
36.86	10.50	V	13.32	1.06	24.88	30.0	5.12
73.73	11.21	V	9.83	1.57	22.61	30.0	7.39
110.59	12.80	H	10.37	1.96	25.13	30.0	4.87
134.98	10.38	V	11.87	2.13	24.38	30.0	5.62
165.51	11.30	V	12.24	2.44	25.98	30.0	4.02
188.11	10.03	V	10.88	2.58	23.49	30.0	6.51
212.66	12.08	V	9.37	2.68	24.13	30.0	5.87
258.05	17.02	V	11.38	3.08	31.48	37.0	5.52
309.57	15.24	V	12.77	3.38	31.39	37.0	5.61
315.21	12.59	V	12.77	3.38	28.74	37.0	8.26
350.21	10.97	H	13.94	3.65	28.56	37.0	8.44
368.64	12.84	H	13.94	3.65	30.43	37.0	6.57

Remarks : * H : Horizontal polarization , ** V : Vertical polarization
 Result value = Reading + Antenna factor + Cable loss
 Margin value = Result value - Limit

Yo Han, Park

Tested by : Yo Han, Park / Test Engineer

7. Sample Calculations

Sample Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor.
 The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF$$

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

$$\text{dB}(\mu\text{V}/\text{m}) = 20 \log_{10} (\mu\text{V} / \text{m}) : \text{Equation 1}$$

$$\text{dB}\mu\text{V} = \text{dBm} + 107 : \text{Equation 2}$$

Example 1 : @ 0.218 MHz

Class B Limit	=	441.063 uV =	52.89 dBuV
Reading	=	48.45dBuV	
Convert to uV	=	264.55uV	
Margin	=	48.45 – 52.89 = -4.44	
	=	-4.44dB below Limit	

Example 2 : @664.64 MHz

Class B Limit	=	70.79 uV = 37.0	dBuV/m
Reading	=	7.38dBuV	
Antenna Factor + Cable Loss	=	25.14	dB
Total	=	32.52	dBuV/m
Margin	=	32.52 – 37.0 = -4.48	
	=	-4.48dB below Limit	

8. Test Summary

Equipment Under Test : OPTICAL MOUSE E SENS M5

FCC Requirement : FCC Rule Part 15 Subpart B Class B

Test Results:

Requirement	Results
15.107	Passed by – 12.55 dB
15.109	Passed by – 4.02 dB

9. List of Test Equipments Used for Measurements

	Test Equipment	Model	Mfg.	Serial No.	Cal. Due Date
☐	Spectrum Analyzer	R3261A	Advantest	21720033	01-10-08
☒	Receiver	ESVS 10	R & S	835165/001	01-04-06
☒	Spectrum Analyzer	R3265A	Advantest	45060321	02-02-28
☒	Preamplifier	HP 8447B	HP	2944A07626	01-03-05
☐	Preamplifier	HP 8347A	HP	2834A00544	01-05-23
☒	TriLog Antenna	VULB9160	Schwarz Beck	3082	01-05-08
☒	LogBicon	VULB9165	Schwarz Beck	2023	01-05-08
☐	Dipole Antenna	VHAP	Schwarz Beck	964	01-05-03
☐	Dipole Antenna	VHAP	Schwarz Beck	965	01-05-03
☐	Dipole Antenna	UHAP	Schwarz Beck	949	01-05-03
☐	Dipole Antenna	UHAP	Schwarz Beck	950	01-05-03
☐	Double Ridged Horn	3115	EMCO	9809-2334	01-09-20
☒	Turn-Table	DETT-03	Daeil EMC	-	N/A
☒	Antenna Master	DEAM-03	Daeil EMC	-	N/A
☒	Plotter	7440A	H.P	2725A 75722	N/A
☒	Chamber	DTEC01	DAETONG	-	N/A
☒	Thermo Hygrograph	3-3122	ISUZU	3312201	01-12-20
☒	BaroMeter	-	Regulus		