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 : TFT LCD MONITOR

Model : ELM-150A/B

Serial Number : Prototype

FCC ID : OIOELM-150

Prepared for :

E-RAE Electronics Industry Co.,Ltd.

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

Prepared by:

Report Date : March 27, 2001

E-RAE Testing Laboratory Inc.

371-51, Gasan-Dong, Geumcheon-Gu,

Seoul, 153-023, Korea

FCC PART 15, SUBPART B
MEASUREMENT REPORT

For

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Prepared by:

E-RAE Testing Laboratory Inc.

Signature	Yo han, Park	Signature	Kayoung Kim
Tested by	Yo Han, Park	Reviewed by	Kayoung Kim
Title	Test Engineer	Title	EMC Lab. Chief Engineer
Date	March 27,2001	Date	March 27,2001

Table of Contents

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 : E-RAE Electronics Industry Co.,Ltd.

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

Attention : Yun Seuk , Yoo / Manager of QA Dept.

EUT Type :	LCD MONITOR
Model Number :	ELM-150A/B
Trade Name :	E-RAE
H-Sync Freq. Range :	**31KHz ~ 60KHz**
V-Sync Freq. Range :	**56Hz ~ 75Hz**
LCD Size :	**15"(SAMSUNG/ TYPE:LMT15XS-T01)**
FCC Rule Part(s) :	FCC Part 15 Subpart B
FCC Procedure :	Certification
Dates of Tests :	Mar. 22 – 24 , 2001
Place of Tests :	E-Rae Testing Lab. EMI Test Site 584, Sangwhal-Ri, Kanam-Myun, Yoju-Kun, Kyounggi-Do, Korea Tel : (031) 885-0072 Fax : (031) 885-0074
Test Report No. :	E01.0327.FCC15B.103.N

1. Introduction

The measurement test for radiated and conductedd emission test were conducted at the open area test site of E-RAE Testing Laboratiry Inc. facility located at 584, Sangwhal-ri, Ganam-myun, Youju-kun, Kyoungki-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 E-RAE Electronics Industry Co.,Ltd. Model : ELM-150 LCD Monitor.

2. Product Information

2.1 Equipment Description

The Equipment Under Test(EUT) Model : ELM-150 by the E-RAE Electronics Industry Co.,Ltd. is the 15" TFT LCD Monitor for Personal Computer Video Display.

2.2 General Specification

- Chassis Type	PLASTIC
-. List of Each OSC. Or X-Tal. Freq.(>=1MHz)	24 MHz
-. Chipset Brand&Part NO.	SAMSUNG : 15ALTM15CXSTC1 MICROCHIP : 19D24LO21A PHILIPS : 19M74LVC126A SST : 19DSST39VF40OA MICROCHIP : 19D24LC16B PIXELWORKS : 19CPM11 MICROCLOCK : 19AICS501M MICROCLOCK : 19AICS502M PHILIPS : 19M74LV273A PHILIPS : 19M74LV0541A
-. Power Consumption	AC100-240V 1.5A 50/60Hz(Output: 12VDC 3A)
-. Number of Layers	MAIN BOARD 4 LAYER AMP BOARD 1 LAYER BACKLIGHT INVERTER BOARD 2 LAYER KEY PAD BOARD 1 LATER

-. Max Resolution	1024X768 NON-INTERLACED(60KHz/75Hz)
-. H-Sync Frequency Range	31KHz ~ 60KHz
-. V-Sync Frequency Range	56Hz ~ 75Hz
-. LCD Size	15" (SAMSUNG/ TYPE:LMT15XS-T01)
-. Video Connector Type	D-SUB 15PIN

2.3 EMI Suppression Device(s)

EMI suppression device(s) added and/or modified during testing : None

3. Description of Tests

3.1 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 biconilog antenna and above 1000MHz, linearly polarized double ridge horn antennas were used.

Final measurements were made outdoors open site at 3-meter test range using biconilog antennas. The outputn from the antenna was connected, via a preselector or a preamplifier, to the input of the spectrum analyzer. 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 pre-scan measurements was reexamined and investigated using Rohde & Schwarz EMI field strength meter.

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 operation to the EUT and/or support equipment and changing the polarity of the antenna, whichever determined the worst-case emission. The worst case emissions are recorded in the data tables. Photographs of the worst-case emission test setup can be seen in Appendix B.

3.2 AC Line Conducted Emission Test

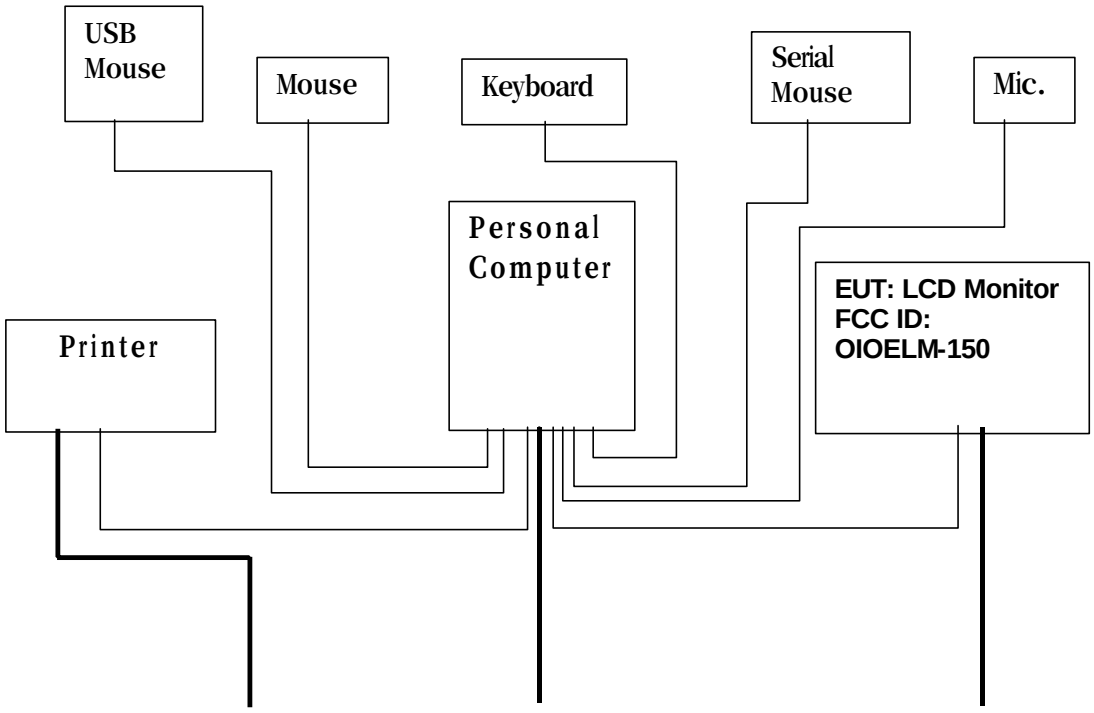
Conducted emissions measurements were made in accordance with § 11 in ANSI C63.4-1992 "Measurement of Information Technology Equipment". The measurement were performed over the frequency range of 0.15MHz to 30MHz using a 50Ω/50uH LISN as the input transducer to a Spectrum Analyzer or a Field Intensity 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. Two EMCO 3825/2 LISN are bonded to the shielded room. The EUT is powered from the EMCO LISN and the support equipment is powered from the 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. Non-inductive bundling to a 1m length shortened all interconnecting cables more than 1m. 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 to set 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.

4. System Test Configuration

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.

4.1 Configuration of test system



POWER Cable
SIGNAL(Interface) Cable

4.1.1 Line Conducted Emission Test

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.

4.1.2 Radiated Emission Test

Preliminary radiated emission tests were conducted using the procedure in ANSI C63.4/1992 Clause 8.3.1.1 to dertimine 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-15"LCD Monitor

FCC ID	: OIOELM-150
Model Name	: ELM-150A/B
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 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	: Parral: 1, USB: 2, Keyboard: 1, Mouse: 1, RS-232: 2

Support Unit 2- 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 3 - MOUSE (LOGITECH)

FCC ID	: DZL211029
Model Name	: M-S34
Serial No.	: LZC01002314
Manufacturer	: LOGITECH
Power Supply Type	: N/A
Power Cord	: N/A
Data Cable	: Shielded, 1.2m

Support Unit 4 – 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 5 – 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 6 – 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 6 – Printer (H.P)

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

5. Preliminary Tests

5.1 AC Power line Conducted Emission Tests

During Preliminary Tests, the following operating mode was investigated.

Processor Speed (MHz)	Video Resolution (w/max)	The worst operating condition
Pentium 633 MHz	1024 x 768 Non- interlaced(60.02KHz/75Hz)	O
Pentium 633 MHz	800 x 600 Non- interlaced(46.88KHz/75Hz)	
Pentium 633 MHz	720 x 400 Non- interlaced(31.47KHz/70Hz)	
Pentium 633 MHz	640 x 480 Non- interlaced(37.5KHz/75Hz)	

5.2 Radiated Emission Tests

During Preliminary Tests, the following operating mode was investigated.

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Processor Speed (MHz)	Video Resolution (w/max)	The worst operating condition
Pentium 633 MHz	1024 x 768 Non-interlaced(60.02KHz/75Hz)	O
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6. Conducted Emissions Test Results

EUT	15" LCD Monitor Model : ELM-150A (SN: Prototype)
Limit apply to	CISPR Pub.22(1985) Class B according to Section 15.109 (g)
Test Date	March 22, 2001
Applicant	E-RAE Electronics Industry Co., Ltd.
Operation Condition	1024x768 60.02KHz(Full ' H' Pattern Display)
	Humidity Level : 37 %RH, Temperature : 22℃
Result	Passed by –5.59dB

Line 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)

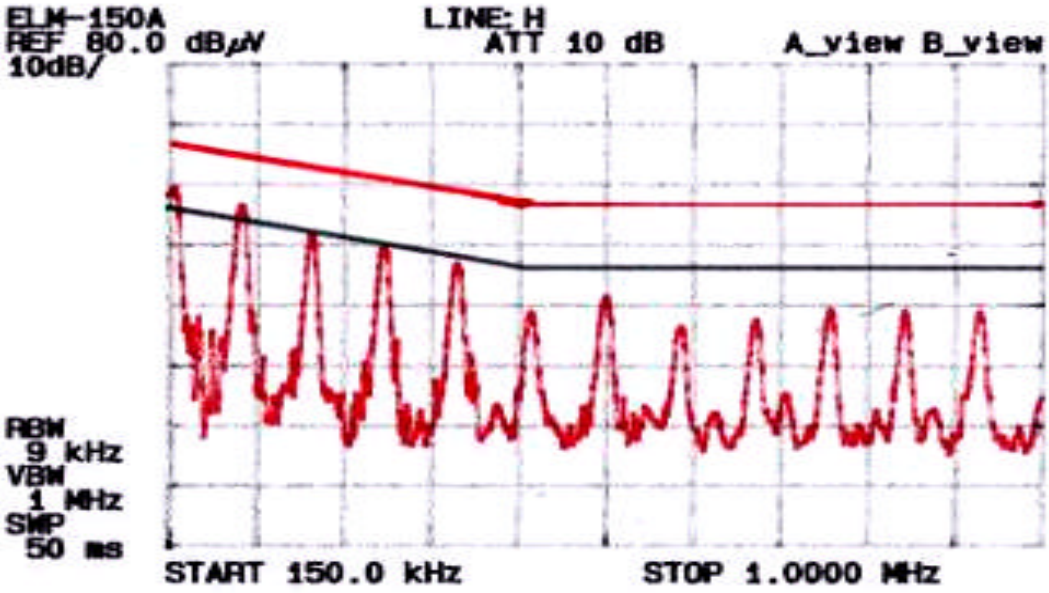
Frequency [MHz]	Reading [dBμV]		Phase (*H/**N)	Limit [dBμV]		Margin [dB]	
	Quasi-peak	Average		Quasi-peak	Average	Q.Peak	Average
0.152	58.55	46.67	H	65.88	55.88	7.33	9.21
0.218	56.62	48.45	N	62.89	52.89	6.27	4.44
0.286	51.52	45.05	N	60.64	50.64	9.12	5.59
0.356	49.75	43.10	N	58.82	48.82	9.07	5.72
0.428	46.92	40.04	N	57.29	47.29	10.37	7.25
0.499	41.05	-	H	56.01	46.01	14.96	-
0.645	37.57	-	N	56.0	46.0	18.43	-
0.792	39.30	-	N	56.0	46.0	16.70	-
4.862	42.72	-	N	56.0	46.0	13.28	-
5.464	43.62	-	N	60.0	50.0	16.38	-
6.114	43.97	-	N	60.0	50.0	16.03	-
6.686	44.22	-	N	60.0	50.0	15.78	-
23.742	43.15	-	N	60.0	50.0	16.85	-

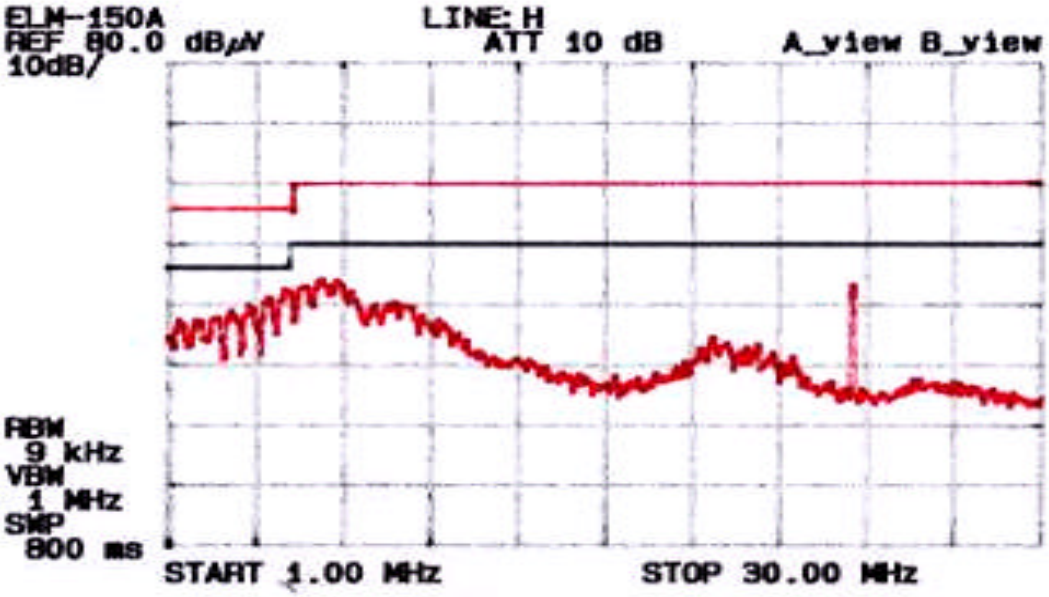
NOTE : * H: Hot Line , ** N: Neutral Line
* Margin = Limit - Reading
* If the Reading Quasi-Peak value is bellow the Average Limit, Do not test Average Mode.
* All conditions were investigated and the worst-case emissions are reported.

Yo han, Park

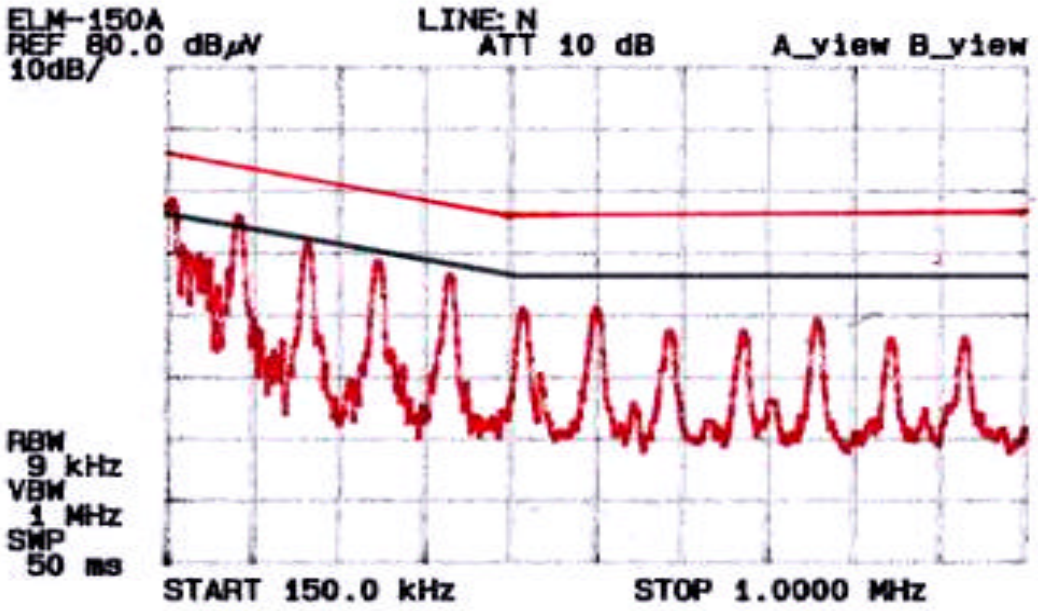
Tested by : Yo Han, Park / Test Engineer

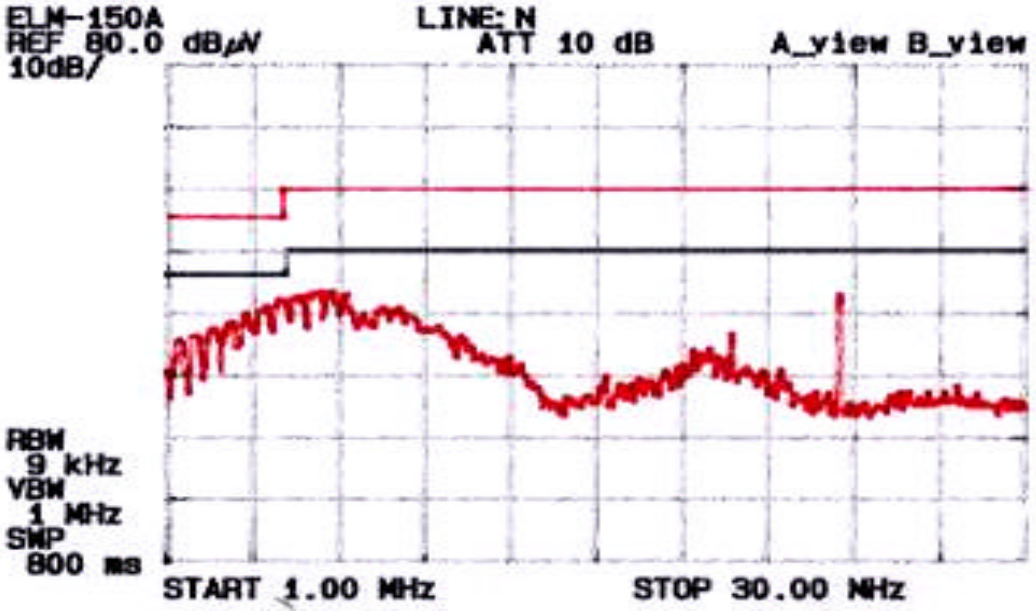
Line Polarization : Hot





Line Polarization : Neutral





7. Radiated Emissions Test Results

EUT	15" LCD Monitor Model : ELM-150A (SN: Prototype)
Limit apply to	CISPR Pub.22(1985) Class B according to Section 15.109 (g)
Test Date	March 24, 2001
Applicant	E-RAE Electronics Industry Co., Ltd.
Operation Condition	1024x768 60.02KHz(Full ' H' Pattern Display)
	Humidity Level : 37 %RH, Temperature : 22℃
Result	Passed by – 4.48dB

Radiated Emission Test Data

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

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

Frequency [MHz]	Reading [dBμV]	Polarization (*H/**V)	Ant. Factor [dB]	Cable Loss [dB]	Result [dBμV/m]	Limit [dB]	Margin [dB]
134.98	9.83	V	12.12	2.18	24.13	30.0	5.87
155.51	7.19	V	12.80	2.39	22.38	30.0	7.62
165.51	10.73	V	12.24	2.44	25.41	30.0	4.59
173.00	10.50	V	11.99	2.48	24.97	30.0	5.03
188.11	10.91	V	9.93	2.65	23.49	30.0	6.51
212.66	12.08	V	9.37	2.68	24.13	30.0	5.87
309.57	15.24	V	12.77	3.38	31.39	37.0	5.61
315.21	12.70	V	12.77	3.38	28.85	37.0	8.15
350.29	10.79	V	13.94	3.65	28.38	37.0	8.62
664.64	7.38	H	19.99	5.15	32.52	37.0	4.48
764.10	3.92	H	21.25	5.50	30.67	37.0	6.33
787.90	3.14	H	21.63	5.70	30.47	37.0	6.53

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

8. 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

$dB(\mu V/m) = 20 \log_{10} (\mu V /m)$: Equation 1
$dB\mu V = dBm + 107$: 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

9. Test Summary

Equipment Under Test : 15" TFT LCD MONITOR ELM-150

FCC Requirement : FCC Rule Part 15 Subpart B

Test Results:

Requirement	Results
15.107	Passed by – 5.59 dB
15.109	Passed by – 4.48 dB

10. List of Test Equipment

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	HP8447B	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		