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EMC CENTER

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FCC EVALUATION REPORT FOR CERTIFICATION

Manufacturer : LG Electronics Inc. - DID DIVISION
642, Jinpyoung-dong, Gumi-city,
Gyeongsangbuk-do, Korea
Attn : Mr. Yeong Hur, EMC Manager

Date of Issue : October 24, 2002
Test Report S/N : GETEC-E3-02-020
Test Site : Gumi College EMC Center

FCC ID	**BEJLM505F**
APPLICANT	**LG Electronics Inc.**

Rule Part(s)	**: FCC Part 15 Subparts B**
Equipment Class	**: Class B Computing Device Peripheral**
Standard(s)	**: EN55022 : 1998 (CISPR22 : 1997)**
EUT Type	**: 15" LCD Monitor**
Model No.	**: LM505F**
Trade name	**: LG**

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-1992.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the vest of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by,

Jea-Woon Choi, EMC engineer
GUMI College EMC center

Reviewed by,

Tae-Sig Park, Technical manager
GUMI College EMC center

CONTENTS

1. SCOPE **3**

2. INTRODUCTION **4**

3. TEST CONDITIONS & EUT INFORMATION **5**

3.1 DESCRIPTION OF EUT 5
3.2 SUPPORT EQUIPMENT USED 6

4. DESCRIPTION OF TESTS **7**

4.1 CONDUCTED EMISSION 7
4.2 RADIATED EMISSIONS 8

5. CONDUCTED EMISSION **9**

5.1 OPERATING ENVIRONMENT 9
5.2 TEST SET-UP 9
5.3 MEASUREMENT UNCERTAINTY 9
5.4 LIMIT 10
5.5 TEST EQUIPMENT USED 10
5.6 TEST DATA FOR CONDUCTED EMISSION 11

6. RADIATED EMISSIONS **13**

6.1 OPERATING ENVIRONMENT 13
6.2 TEST SET-UP 13
6.3 MEASUREMENT UNCERTAINTY 13
6.4 LIMIT 14
6.5 TEST EQUIPMENT USED 14
6.5 TEST DATA FOR RADIATED EMISSION 15

7. SAMPLE CALCULATIONS **16**

7.1 EXAMPLE 1 : 16
7.2 EXAMPLE 2 : 16

8. RECOMMENDATION & CONCLUSION **17**

APPENDIX A – ATTESTATION STATEMENT
APPENDIX B – PLOTS OF CONDUCTED EMISSIONS
APPENDIX C – ID SAMPLE LABEL & LOCATION
APPENDIX D – BLOCK DIAGRAM
APPENDIX E – TEST SET-UP PHOTOGRAPHS
APPENDIX F – EXTERNAL PHOTOGRAPHS
APPENDIX G –INTERNAL PHOTOGRAPHS
APPENDIX H – USER'S MANUAL

1. Scope

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

Responsible Party: **LG Electronics Inc.**

Contact Person: **Mr. Yeong Hur, EMC Manager**
Product Engineering Dept., Safety & EMC Team
Digital Information Display Division

Manufacturer: **642, Jinpyoung-dong, Gumi-city, Gyeongsangbuk-do, Korea**
Tel No.: +82-54-470-2933

- **FCC ID** BEJLM505F
- **Equipment Class** Class B Computing Device Peripheral
- **EUT Type** 15” LCD Monitor
- **Model No.** LM505F
- **Max. Resolution** 1024×768 Non-interlaced @ 75Hz
- **Frequency Range** H-Sync: 30kHz – 60kHz
  V-Sync: 56Hz – 75Hz
- **Trade Name** LG
- **Power Cord** Unshielded AC Power Cord
- **Rule Part(s)** FCC Part 15 Subparts B
- **Standard(s)** EN55022:1998 (CISPR22:1997)
- **Test Procedure(s)** ANSI C63.4 (1992)
- **Dates of Test** October 22 ~ 23, 2002
- **Place of Test** Gumi College EMC Center
- **Test Report No.** GETEC-E3-02-020

2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ASNI C63.4-1992) was used in determining radiated and conducted emissions emanating from **LG Electronics Inc. 15" LCD Monitor (Model No.: LM505F)**

These measurement tests were conducted at **Gumi College EMC Center**.
The site address is 407, Bugok-Dong, Gumi-Si, Gyeongsangbuk-Do, Korea
This test site is one of the highest point of Gumi 1 college at about 200 kilometers away from Seoul city and 40 kilometers away from Daege city. It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures. The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.4 on October 19, 1992

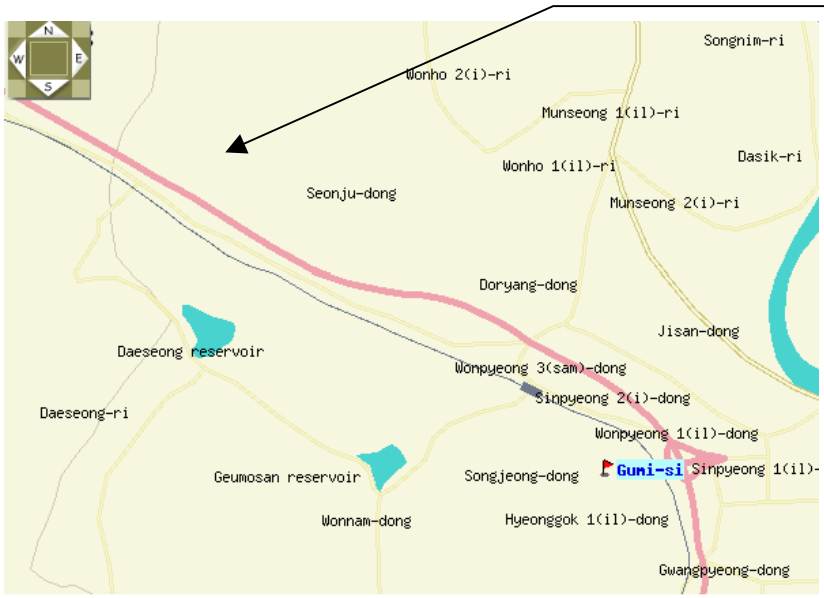

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Fig 1. The map above shows the Gumi College in vicinity area.

3. Test Conditions & EUT Information

3.1 Description of EUT

The Equipment Under Test (EUT) is the **LG Electronics Inc. 15" LCD Monitor (Model No.: LM505F)**
FCC ID : BEJLM505F

Maximum Resolution(s)	1024×768 Non-interlaced @ 75Hz
Frequency Range(s)	H-Sync: 30kHz – 60kHz V-Sync: 56Hz – 75Hz
Power supply	AC 100-240V, 50/60Hz, 0.6A
Power Cord	1.8m Unshielded AC power cord
Cable(s)	1.8m Shielded D-sub with ferrite on both ends
	1.5m Unshielded Sound cable with a ferrite core
	1.5m Unshielded S-VHS cable with a ferrite core
	2.95m Unshielded External cable with a ferrite core
Dimensions	36.02×35.98×15.30cm
TV tuner pack	IND Tek Co., Ltd. (Model No.: IND-TU 350NM) S/N: 6700NF0006

3.2 Support Equipment used

PC	COMPAQ PD1075 S/N: 7041JC8F0245 FCC ID: DoC 1.8m Unshielded AC power cord	Connected to the EUT and Peripheral equipments
Video card	ATI Radeon VE S/N: 6001833 FCC ID: DoC	Connected to the EUT
Printer	H.P Deskjet 970cxi S/N: MYPB01F1FG FCC ID: DoC 1.5m Shielded printer cable	Connected to the parallel Port of PC
Joystick	Microsoft X05-92626 S/N: 9262600296169 FCC ID: DoC 1.8m Shielded joystick cable	Connected to the USB port of PC
Serial Mouse	Microsoft 61402 S/N: 00696998 FCC ID: C3KKS3 1.8m Shielded data cable	Connected to the serial port of PC
PS/2 Key-board	COMPAQ 166516-AD6 S/N: B13BBOR39I006D FCC ID: AQ6-23K15 2.3m Shielded data cable	Connected to the PS/2 port of PC
Head phone	Gowoonsori GW-500M 2.85m Shielded head phone cable	Connected to the head phone port of EUT
DVD player	PIONEER DV-525 S/N: UEYD012398LL FCC ID: DoC 1.8m Shielded DVD cable	Connected to the EUT

See "Appendix E – Test Setup Photographs" for actual system test set-up

4. Description of tests

4.1 Conducted Emission

The Line conducted emission test facility is inside a 4×8×2.5 meter shielded enclosure.
The EUT was placed on a non-conducting 1.0 by 1.5 meter table, which is 0.8 meters in height and 0.4 meters away from the vertical wall of the shielded enclosure.
The EUT was powered from the Rohde & Schwarz LISN (ESH2-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH3-Z5). Powers to the LISN are filtered by high-current high insertion loss power line filter.
Sufficient time for 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 EMI test receiver (Rohde & Schwarz, ESCS30).
The EMI test receiver was scanned from 150kHz to 30MHz with 20msec sweep time to determine the frequency producing the maximum EME from the EUT. The frequency producing the maximum level was re-examined using Quasi-Peak mode of the EMI test receiver.
The bandwidth of Quasi-peak mode was set to 9KHz. Each emission was maximized consistent with typical applications by varying the configuration of the test sample. Interface cables were connected to the available interface ports of the test unit. The effect of varying the position of cables was investigated to find the configuration that produces maximum diagram emission. Excess cable lengths were bundled at center with 30 – 40 centi-meters.
The worst operating condition of the test sample was found out by varying operating mode(PC mode, TV mode, DVD mode).
And, the test 5 modes (1024*768/75Hz, 800*600/75Hz, 640*480/60Hz, Composite signal input, S-VHS signal input) and configuration were noted in the test report and the photographs were attached.
Each EME reported was calibrated using the R/S signal generator

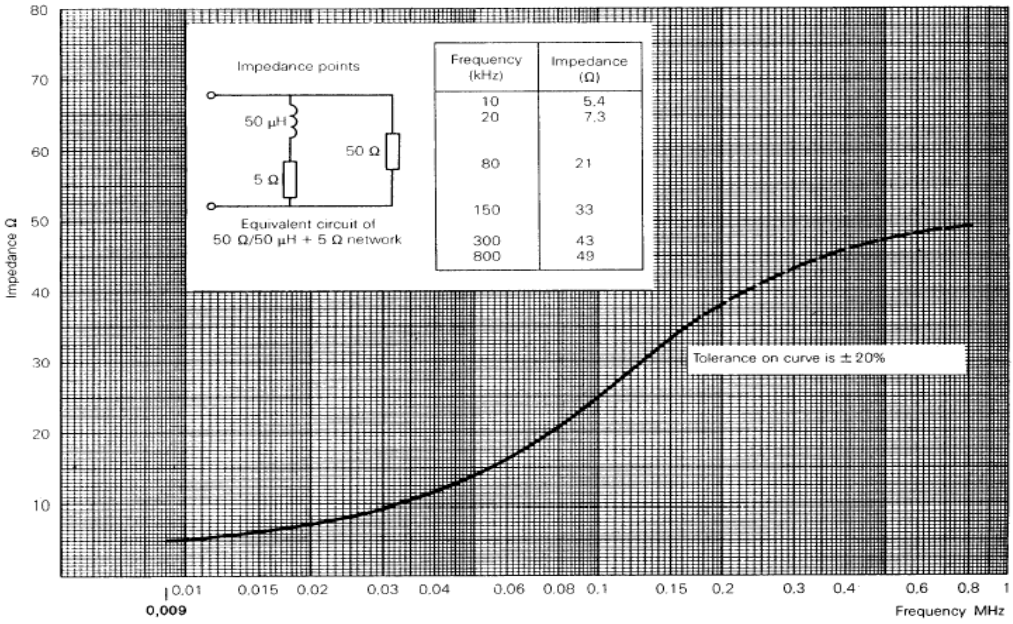


Fig 2. Impedance of LISN

4.2 Radiated Emissions

Preliminary measurements were conducted 3m semi anechoic chamber using broadband antennas to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The technology configuration, mode of operation and turntable azimuth with respect to antenna was note for each frequency found.

The spectrum was scanned from 30 to 1000MHz using biconical log antenna (Schwarzbeck, VLB9160). Above 1GHz, horn antenna (Schwarzbeck, BBHA9120D) was used.

Final measurements were made outdoors at 10m-test range using biconical antenna (R&S, HK116) and log-periodic antenna (R&S, HL223).

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 re-examined and investigated using EMI test receiver. (ESCS30)

The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 120KHz or 1MHz depending on the frequency or type of signal.

The EUT, support equipment and interconnecting cables were reconfigured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8m high non-metallic 1.0×1.5 meter table.

The turntable containing the test sample was rotated; the antenna height was varied 1 to 4 meter and stopped at the azimuth or height producing the maximum emission.

Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling “H” pattern to the EUT and / or support equipment and powering the monitor from mounted outlet box, if applicable; and changing the polarity of the antenna whichever determined the worst case emission.

The worst-case test mode (1024*768/75Hz) and configuration was noted in the test report and the photographs were attached.

Each EME reported was calibrated using the R/S signal generator

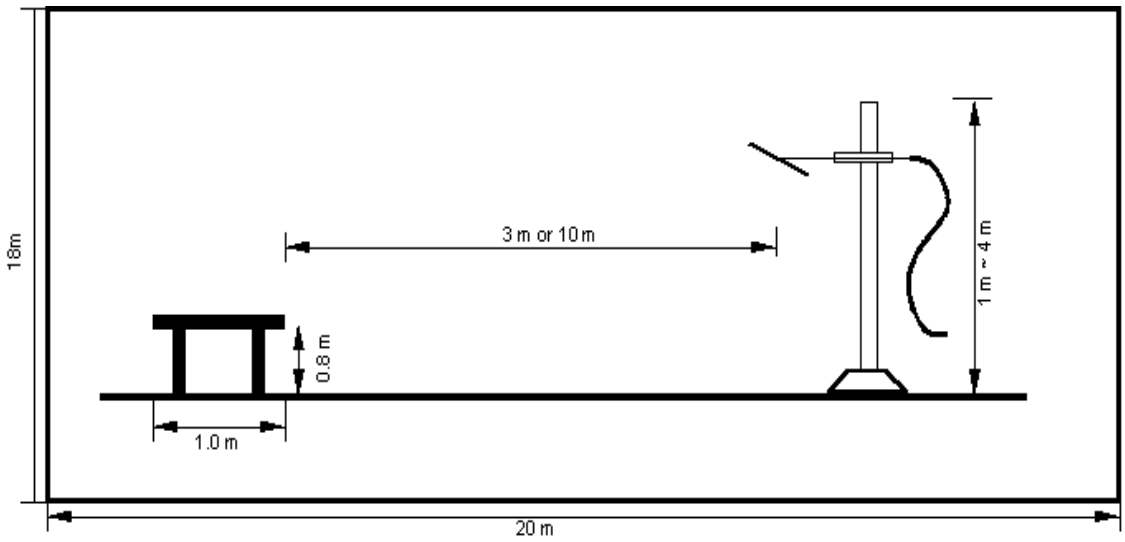


Fig 3. Dimensions of Open Site Test Area

5. Conducted emission

5.1 Operating environment

Temperature : 21℃
Relative humidity : 32 %

5.2 Test set-up

The conducted emission measurements were performed in the shielded room.
The EUT was placed on wooden table, 0.8m heights above the floor, 0.4m from the reference ground plane (GRP) wall and 0.8m from AMN.
AMN is bonded on horizontal reference ground plane.
The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, was filtered.

5.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO "Guide to the expression of uncertainty in measurement".
The measurement uncertainty was given with a confidence of 95%.

Contribution	Probability Distribution	Uncertainty (+/-dB)
Receiver Specification	Normal (k=2)	±1.0
LISN coupling spec.	Normal (k=2)	±1.5
Cable and input attenuator cal.	Rectangular	±0.04
Mismatch : Receiver VRC ri =0.3 Antenna vrc rg=0.1 Uncertainty Limits 20Log(1+/-ri rR)	U-Shaped	±0.61
System Repeatability	Std. deviation	±0.35
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	±1.18
Expended Uncertainty U	Normal (k=2)	±2.36

5.4 Limit

RFI Conducted	FCC Class B Limits dB (μV/m)	CISPR 22 Class B Limits dB (μV/m)	
Freq. Range	FCC Class B Quasi-Peak	CISPR 22 Quasi-Peak	CISPR 22 Average
150kHz – 0.5MHz	48*	66 – 56**	56 – 46**
0.5MHz – 5MHz	48	56	46
5MHz – 30MHz	48	60	50
*FCC Class B limits starts from 450kHz **Limits decreases linearly with the logarithm of frequency.			

5.5 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Calibrated Date
■ -	ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	01. 17. 2002
■ -	ESH3-Z5	Rohde & Schwarz	Artificial mains network	838979/020	01. 17. 2002
■ -	ESH2-Z5	Rohde & Schwarz	Artificial mains network	829991/009	01. 17. 2002

All test equipment used is calibrated on a regular basis.

5.6 Test data for conducted emission

-. Test Date : October 22, 2002
-. Test Pattern : Scrolling "H"s, Winamp player, Color bar, DVD display mode
-. Resolution bandwidth : 9kHz
-. Frequency range : 0.15MHz ~ 30MHz
-. Remark : AC Power Source: AC 120V, 60Hz

■. Test mode: 1024*768/75Hz

Frequency (MHz)	Line	Quasi-Peak (dBuV)		Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	limits		Emission level	limits	
0.15	H	40.35	66.00	25.65	33.75	56.00	22.25
0.2	N	49.78	63.61	13.83	44.58	53.61	9.03
0.27	N	43.46	61.12	17.66	35.26	51.12	15.86
0.335	N	37.39	59.33	21.94	27.19	49.33	22.14
0.69	N	32.51	56.00	23.49	23.21	46.00	22.79
24.04	H	29.87	60.00	30.13	30.13	50.00	20.03

Note : "H": Hot Line, "N": Neutral line.

■. Test mode: 800*600/75Hz

Frequency (MHz)	Line	Quasi-Peak (dBuV)		Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	limits		Emission level	limits	
0.15	H	43.45	66.00	22.55	31.75	56.00	24.25
0.2	N	46.58	63.61	17.03	37.58	53.61	16.03
0.21	N	45.06	63.21	18.14	33.16	53.21	20.04
24.04	H	29.87	60.00	30.13	30.07	50.00	19.93

Note : "H": Hot Line, "N": Neutral line.

■. Test mode: 640*480/60Hz

Frequency (MHz)	Line	Quasi-Peak (dBuV)		Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	limits		Emission level	limits	
0.15	H	43.05	66.00	22.95	31.55	56.00	24.45
0.2	N	47.98	63.61	15.63	38.68	53.61	14.93
0.21	N	45.86	63.21	17.34	34.16	53.21	19.04
0.34	N	35.49	59.20	23.71	26.89	49.20	22.31
24.04	H	31.37	60.00	28.63	31.67	50.00	18.33

Note : "H": Hot Line, "N": Neutral line.

■. Test mode: Composite signal input

Frequency (MHz)	Line	Quasi-Peak (dBuV)		Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	limits		Emission level	limits	
0.2	N	49.98	63.61	13.63	45.08	53.61	8.53
0.21	N	48.56	63.21	14.64	40.26	53.21	12.94
0.33	N	37.38	59.45	22.07	28.98	49.45	20.47
0.695	N	34.11	56.00	21.89	24.91	46.00	21.09

Note : "H": Hot Line, "N": Neutral line.

■. Test mode: S-VHS signal input

Frequency (MHz)	Line	Quasi-Peak (dBuV)		Margin (dB)	Average (dBuV)		Margin (dB)
		Emission level	limits		Emission level	limits	
0.2	N	50.38	63.61	13.23	45.08	53.61	8.53
0.21	N	48.86	63.21	14.34	39.86	53.21	13.34
0.33	N	37.88	59.45	21.57	37.68	49.45	11.77
0.69	N	33.81	56.00	22.19	24.21	46.00	21.79
3.58	H	41.48	56.00	14.52	37.38	46.00	8.62

Note : "H": Hot Line, "N": Neutral line.

6. Radiated emissions

6.1 Operating environment

Temperature : 28℃
Relative humidity : 35 %

6.2 Test set-up

A preliminary scan with peak mode was performed in the semi anechoic chamber and found frequency for open area test site.
The formal radiated emission was measured at 10m-distance open area test site.
The EUT was placed on a non-conductive turntable approximately 0.8 meters above the ground plane.
The turntable with EUT was rotated 360°, and the antenna was varied in height between 1.0 and 4.0 meters in order to determine the maximum emission levels.
This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

6.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO "Guide to the expression of uncertainty in measurement".
The measurement uncertainty was given with a confidence of 95%.

Contribution	Probability Distribution	Uncertainty (+/-dB)	
		Biconical ANT	Log-periodic ANT
Antenna Factor	Normal (k=2)	±1.0	±1.0
Cable Loss	Normal (k=2)	±0.13	±0.13
Receiver Specification	Rectangular	±1.0	±1.0
Antenna directivity	Rectangular	±1.35	±4.85
Antenna Factor variation with Height			
Antenna Phase Center Variation			
Antenna Factor Frequency Interpolation			
Measurement Distance Variation			
Site imperfections	Rectangular	±2.09	±2.29
Mismatch : Receiver VRC ri =0.3 Antenna VRC rR =0.1(Bi)0.4(Lp) Uncertainty Limits 20Log(1+/-ri rR)	U-Shaped	±0.52	±0.49
System Repeatability	Std. deviation	±0.35	±0.53
Repeatability of EUT	-	-	-
Combined Standard Uncertainty	Normal	±1.59	±2.49
Expended Uncertainty U	Normal (k=2)	±3.18	±4.99

6.4 Limit

Frequency (MHz)	FCC Limit @ 3m. Quasi-Peak dB (μV/m)	FCC Limit @ 10m. Quasi-Peak dB (μV/m)	CISPR Limit @ 10m. Quasi-Peak dB (μV/m)
30 – 88	40.0	29.5	30.0
88 – 216	43.5	33.0	30.0
216 – 230	46.0	35.6	30.0
230 – 960	46.0	35.6	37.0
960 – 1000	54.0	43.5	37.0
> 1000	54.0	43.5	No Specified limit
*Limit extrapolated 20dB / decade			

6.5 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Calibrated Date
■ -	ESCS30	Rohde & Schwarz	EMI test receiver	839809/003	01. 17. 2002
■ -	HK116	Rohde & Schwarz	Biconical antenna	836239/007	02. 04. 2002
■ -	HL223	Rohde & Schwarz	Log-periodic antenna	835998/004	02. 04. 2002
■ -	HD100	HD GmbH	Position Controller	100/692/01	NCR
■ -	DS415S	HD GmbH	Turntable	415/657/01	NCR
■ -	MA240	HD GmbH	Antenna Master	240/565/01	NCR

6.5 Test data for radiated emission

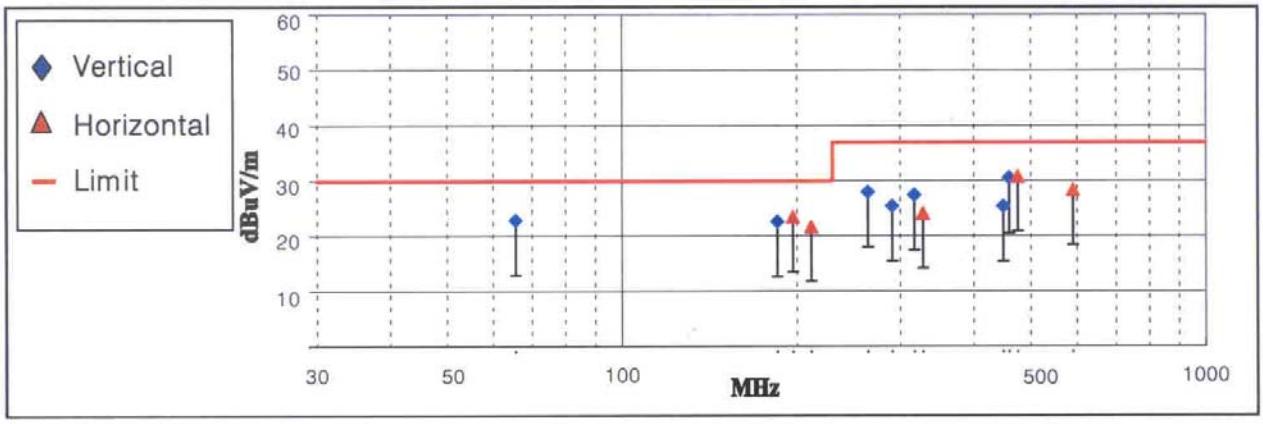
-. Test Date : October 23, 2002
-. Test Pattern : Scrolling "H"s, Winamp player
-. Resolution bandwidth : 120kHz
-. Frequency range : 30MHz ~ 1000MHz
-. Remark : AC Power Source: AC 120V, 60Hz

■. Test mode: 1024*768/75Hz

Frequency (MHz)	Reading (dBuV)	Ant. Pol. (H/V)	Ant. Factor(dB/m)	Cable Loss	Emission Level(dBuV/m)	Limits (dBuV/m)	Margin (dB)
65.63	12.7	V	7.82	2.28	22.8	30.0	7.2
185.06	5.6	V	13.33	3.65	22.6	30.0	7.4
196.88	5.8	H	13.88	3.77	23.4	30.0	6.6
211.51	3.4	H	14.44	3.89	21.7	30.0	8.3
264.36	7.2	V	16.40	4.31	27.9	37.0	9.1
317.26	9.4	V	13.21	4.74	27.4	37.0	9.6
459.56	7.8	V	16.77	5.88	30.4	37.0	6.6
475.89	8	H	16.80	6.01	30.8	37.0	6.2
590.65	3.4	H	18.29	6.65	28.3	37.0	8.7

Note: "H": Horizontal, "V": Vertical

[Quasi- peak detector mode]



< Fig 4. Radiated emission result>

7. Sample calculations

$$dB\mu V = 20 \text{ Log}_{10}(\mu V/m)$$
$$dB\mu V = dBm + 107$$
$$\mu V = 10^{(dB\mu V/20)}$$

7.1 Example 1 :

■ **20.3 MHz**

Class B Limit	=	**250 μV**	=	**48 dBμV**
Reading	=	**- 67.8 dBm(Calibrated level)**		
Convert to dBμV	=	**- 67.8 dBm + 107**	=	**39.2 dBμV**
$10^{(39.2dB\mu V/20)}$	=	**91.2 dBμV**		
Margin	=	**39.2 – 48**	=	**-8.8**
	=	**8.8 dB below Limit**		

7.2 Example 2 :

■ **66.7 MHz**

Class B Limit	=	**100 μV/m**	=	**40.0 dBμV/m**
Reading	=	**- 76.0 dBm(Calibrated level)**		
Convert to dBμV/m	=	**- 67.8 dBm + 107**	=	**31.0 dBμV/m**
Antenna Factor + Cable Loss	=	**5.8 dB**		
Total	=	**36.8 dBμV/m**		
Margin	=	**36.8 – 40.0**	=	**-3.2**
	=	**3.2 dB below Limit**		

8. Recommendation & conclusion

The data collected shows that the Gumi College EMC Center.
LG Electronics Inc. 15" LCD Monitor (Model No.: LM505F) was complies with §15.107 and 15.109 of the FCC Rules.

The highest emission observed was at 0.2MHz for conducted emission with a margin of 8.53dB (S-VHS mode), at 475.89MHz for radiated emissions with a margin of 6.2dB.