

# MEASUREMENT / TECHNICAL REPORT

**HYUNDAI ELECTRONICS INDUSTRIES CO.,LTD.**

**MODEL : HLM-1500A**

This report concerns(check one) : Original grant  Class change

Equipment type : LCD MONITOR

Deferred grant requested per 47 CFR 0.457(d)(1)( ) ? yes  no

If yes, defer until:

   agrees to notify the Commission by

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by : BONG JAE, HUR General Manager of QA Office

Company : HYUNDAI ELECTRONICS INDUSTRIES CO., LTD.

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## 1. GENERAL INFORMATION

### 1.1 Product Description

The Hyundai Electronics Industries Co., Ltd. Model (referred to as the EUT in this report) is a 15" COLOR LCD Monitor HOR. Freq. 68.7 kHz w/max. Resolution of 1024×768 Non-Interlaced.

Product specification information described herein was obtained from product data sheet or user's manual.

CHASSIS TYPE	PLASTIC
LIST OF EACH OSC. OR XTAL. FREQ.(FREQ. 1MHz)	20 MHz
CHIPSET BRAND AND PART NO.	Pixelworks : PW164-10R T.I : 74VC126 ICS : ICS502M ICS : ICS501M PHILLIPS: HEF4052BT SONY: CXA1875 DALLAS: DS 1708T
POWER REQUIREMENT	100 - 240 VAC 50/60Hz 2.5A
NUMBER OF LAYERS	MAIN BOARD 4 LAYER OSD BOARD 1 LAYER POWER BOARD 1 LAYER INVERTER BOARD 2 LAYER LCD MODULE BOARD 6 LAYER
MAX. RESOLUTION	1024 X 768 NON-INTERLACED (@ 68.7 kHz/85 Hz)
H-SYNC FREQUENCY RANGE	31.3 kHz 68.7kHz
V-SYNC FREQUENCY RANGE	56 Hz 85 Hz
LCD SIZE	15" ( HYUNDAI / Type : HT15X11-100)

### 1.2 Related Submittal(s) / Grant(s)

ORIGINAL SUBMITTAL ONLY

### 1.3 Tested System Details

**The Model names for all equipment, plus descriptions used in the tested system (including inserted cards) are:**

DEVICE TYPE	MANUFACTURER	MODEL NUMBER	FCC ID / DoC	CONNECTED TO
LCD COLOR MONITOR(EUT)	HYUNDAI	HLM-1500A	CKLHLM-1500A1	HOST
PC(HOST)	COMPAQ	DESK Pro	DoC	N/A
KEYBOARD	H/P	SK-2502C	DoC	HOST
PRINTER	H/P	HP895C	DoC	HOST
MODEM	3 COM	56K FAX Modem	DoC	HOST
VIDEO CARD	ATI	ATI RAGE PRO	DoC	HOST
MOUSE	H/P	M-S34	DZL211029	HOST

## 1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4/1992. Radiated testing was performed at an antenna to EUT distance of 10 meters.

## 1.5 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data are located at the 254-1,MAEKOK-RI,HOBUP-MYUN,ICHON-SI,KYOUNGKI-DO, 467-701,KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22. Detailed description of test facility was submitted to the Commission on May 22, 1997 and accepted dated July 25,1997(1300F2)

## 2.SYSTEM TEST CONFIGURATION

## 2.1 Justification

The device was configured for testing in a typical fashion (as a customer would normally use it). During the tests, the following components and I/O cards inside the E.U.T were used.

DEVICE TYPE	MANUFACTURE	MODEL/PART NUMBER
MAIN BOARD	HYUNDAI	E4205015501
OSD BOARD	HYUNDAI	3010700722
POWER BOARD	HYUNDAI	361020007601
INVERTER BOARD	HYUNDAI	3610400213
LCD MODULE BOARD	HYUNDAI	HT15X11-MLT4L1.0

## 2.2 EUT exercise Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The software, contained on a 3-1/2 inch disc, was inserted into drive A and is auto starting on power-up. Once loaded, the program sequentially exercises each system component in turn. The sequence used is :(1) Display test, (2) RS 232 test (3) Key board test,(4) Printer test,(5) FDD test,(6) HDD test. The complete cycle takes about 20 seconds and is repeated continuously. As the keyboard and mouse are strictly input devices, no data is transmitted to them during test. They are however, continuously scanned for data input activity. The video resolution modes setup and change program was used during the radiated and conducted emission testing.

## 2.3 Cable Description

	Power Cord Shielded (Y/N)	I/O Cable Shielded (Y/N)	Length (M)
PC(HOST)	N	N/A	1.8(P)
LCD COLOR MONITOR(EUT)	N	Y	1.8(P), 1.5(D)
PRINTER	N	Y	2.0(P),1.5(D)
KEYBOARD	N/A	Y	2.0(D)
MODEM	N	Y	2.0(P),1.5(D)
MOUSE(PS/2)	N/A	Y	1.8(D)

The marked "(D)" means the Data Cable and "(P)" means the Power Cable.

## 2.4 Noise Suppression Parts on Cable.

	Ferrite Bead (Y/N)	Location	Metal Hood (Y/N)	Location
PC(HOST)	N	N/A	N	N/A
PRINTER	N	N/A	Y	BOTH END
KEYBOARD	Y	PC END	N	N/A
MODEM	N	N/A	Y	BOTH END
MOUSE(PS/2)	N	N/A	N	N/A
MONITOR(EUT)	Y	BOTH END	Y	BOTH END

## 2.5 Equipment Modifications

**N/A**

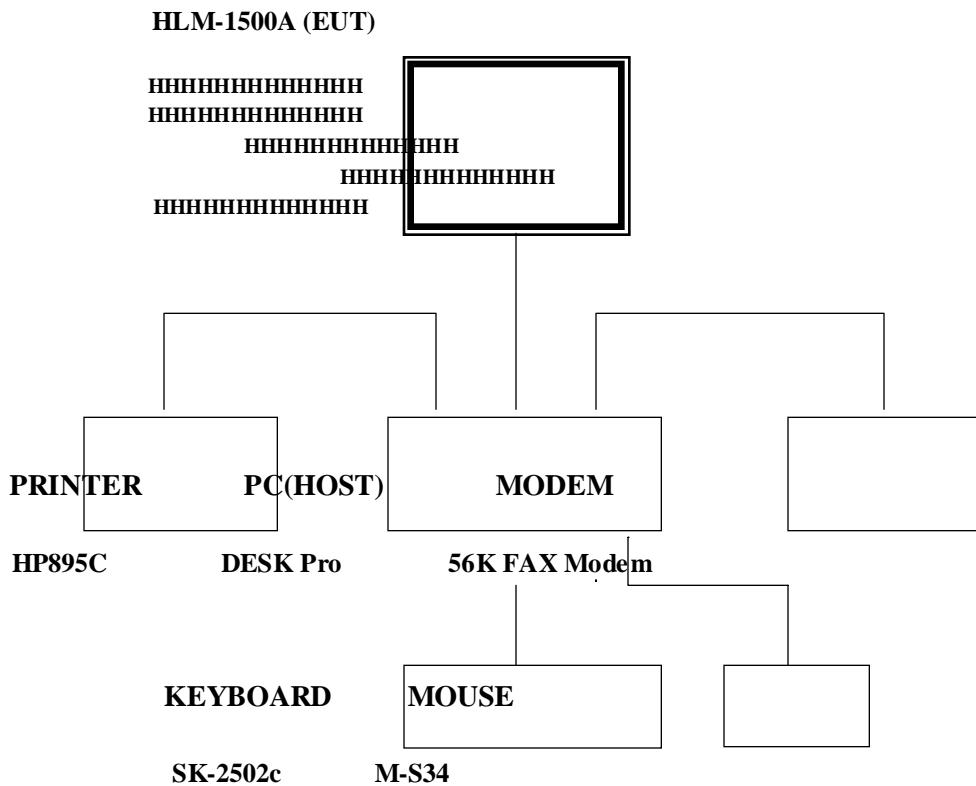
## 2.6 Configuration of Test system

**Line Conducted 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 7.2.3 to determine the worse operating conditions.

**Radiated Emission Test** : Preliminary Radiated Emissions tests were conducted using the procedure in ANSI C63.4/1992 8.3.1.1 to determine the worse operating condition. Final Radiated Emission tests were conducted at 3 meter open area test site.

### [Configuration of Tested System]



### 3. PRELIMINARY TESTS

#### 3.1 AC Power line Conducted Emission Tests

During Preliminary Tests, the following operating mode were investigated

Processor Speed (MHz)	Video Resolution (w/max)	The worst operating condition
Pentium 350 MHz	1024 x 768 Non-Interlaced (68.7kHz/85Hz)	X
Pentium 350 MHz	800 x 600 Non-Interlaced (53.6 kHz/85Hz)	
Pentium 350 MHz	640 x 480 Non-Interlaced (43.3 KHz/85Hz)	
Pentium 350 MHz	640 x 350 Non-Interlaced (31.5 KHz/70Hz)	

#### 4.2 Radiated Emission Tests

During Preliminary Tests, the following operating mode were investigated

Processor Speed (MHz)	Video Resolution (w/max)	The worst operating condition
Pentium 350 MHz	1024 x 768 Non-Interlaced (68.7kHz/85Hz)	X
Pentium 350 MHz	800 x 600 Non-Interlaced (53.6 kHz/85Hz)	
Pentium 350 MHz	640 x 480 Non-Interlaced (43.3 KHz/85Hz)	
Pentium 350 MHz	640 x 350 Non-Interlaced (31.5 KHz/70Hz)	

Tested by KEUN HO, PARK

Date : MAR. 23. 2000

## 4. FINAL CONDUCTED AND RADIATED EMISSION TESTS SUMMARY

### 4.1 Conducted Emission Test

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

Humidity Level : 35%                      Temperature : 20  
 Limit apply to : CISPR 22  
 Type of Tests : CLASS B  
 Date : MAR. 24, 2000  
 Result : PASSED BY -11.2dB  
 EUT : 15" LCD COLOR MONITOR

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Operating Condition : 1024 X 768 Non-Interlaced (Hf : 68.7 KHz, Vf : 85Hz)

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

#### Line Conducted Emission Tabulated Data

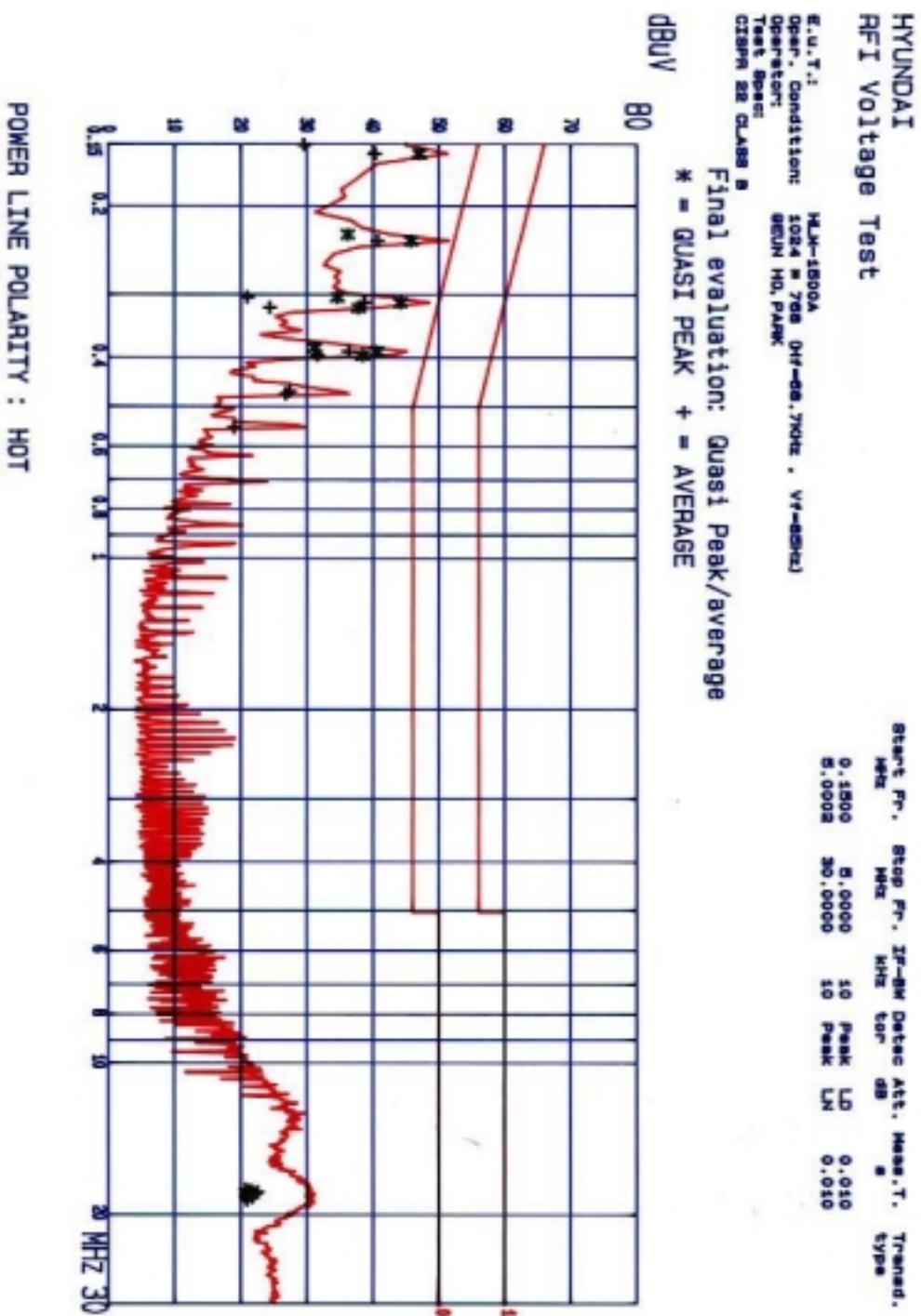
Power Line Conducted Emissions			CISPR 22 (Average)	
Frequency (MHz)	Amplitude (dBuV)	Conductor	Limit (dBuv)	Margin (dB)
0.234	40.8	H	52.4	-11.6
0.311	38.8	H	50.0	-11.2
0.388	36.4	H	48.2	-11.8
0.234	40.3	N	52.4	-12.1
0.311	38.2	N	50.0	-11.8

#### NOET:

1. All video modes and resolutions were investigated and the worst-case emissions are reported  
Other video modes & resolution were tested and found to be in compliance.

Measured by : KEUN HO, PARK / Engineer

Date : MAR. 24. 2000



**HYUNDAI**  
**RFI Voltage Test**

E.U.T.: **HEI-1500A**  
 Oper. Condition: **100A in 75Ω DUT=0Ω, 70Hz, VPE=10V**  
 Operator: **SEUNG HO PARK**  
 Test Spec: **CLASS 22 CLASS B**

Start Freq. Hz	Stop Freq. Hz	IF-BW kHz	Att. dB	Max. T. type	Transd.	Quasi-Peak values Peak dBUV	0-Peak up-Margin dBUV dB
0.1500	5.0000	10	Peak	LD	0.010	0.1570 51.4	47.0 -18.0
0.0002	50.0000	10	Peak	LN	0.010	0.2270 49.7	38.8 -26.4
						0.2340 51.7	45.9 -18.5
						0.3040 49.0	34.7 -26.5
						0.3110 49.8	44.2 -15.8
						0.3180 41.0	37.9 -21.9
						0.3810 39.8	31.2 -27.3
						0.3880 45.3	40.6 -17.6
						0.3900 43.0	38.4 -18.6
Average values Frequency Hz				Peak dBUV		Average dBUV	Average-Margin dB
0.1500		45.0		29.6		-26.4	
0.1570		51.4		40.4		-15.4	
0.2240		51.7		40.8		-11.6	
0.3040		49.0		21.0		-89.2	
0.3110		48.8		38.8		-11.2	
0.3180		41.0		24.5		-85.3	
0.3880		45.3		38.4		-11.8	
0.3900		43.0		31.7		-16.3	
0.4680		38.0		27.8		-19.1	
0.4780		36.8		28.9		-19.7	
0.5480		30.1		19.1		-88.9	
1.7.8032		30.8		20.8		-88.2	
1.7.8872		30.8		21.1		-88.9	
1.7.9642		30.8		21.6		-88.4	
18.0412		30.1		22.6		-87.4	
18.1182		31.1		22.2		-87.8	
18.1902		30.8		20.8		-88.2	
18.4932		30.8		21.0		-88.1	
18.5102		30.0		20.8		-89.2	
18.6642		30.3		21.1		-88.9	

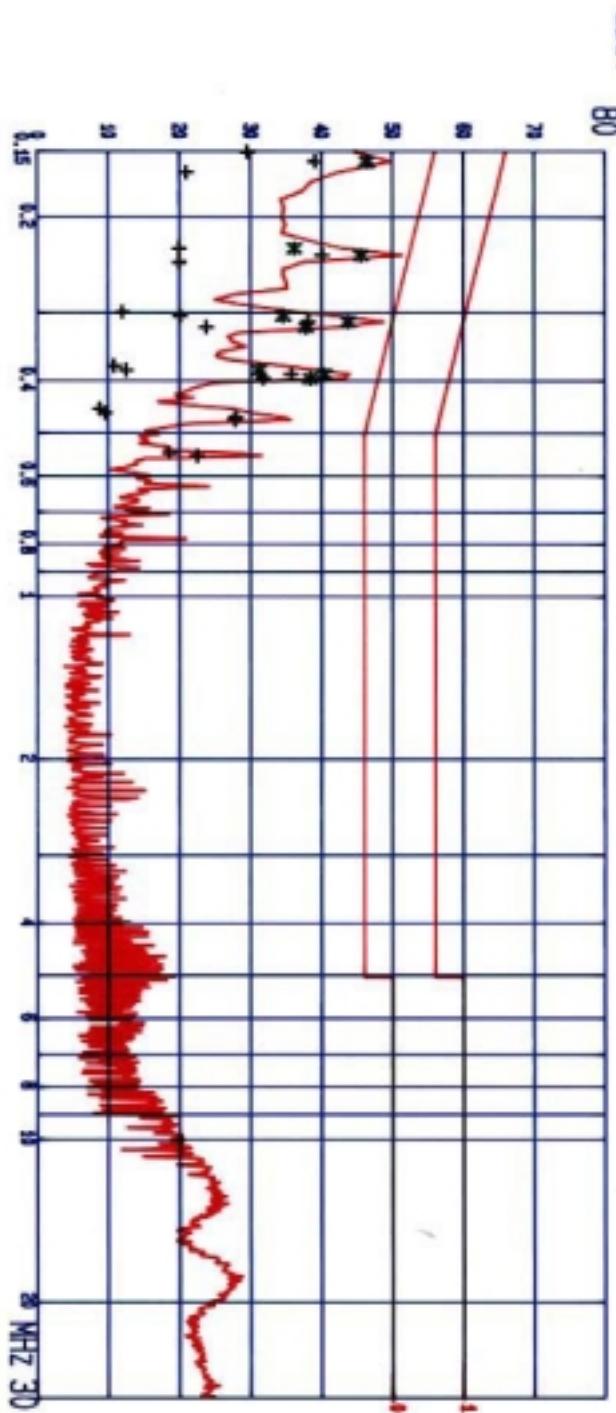
<sup>u</sup> Limit exceeded

**HYUNDAI**  
**RFI Voltage Test**

E.U.T.: HLM-1500A  
Oper. Condition: 1084 = 788 (44-63,700Hz, VFM=60Hz)  
Operator: BEHN HD, PARK  
Test Spec: CISPR 22 CLASS B

Final evaluation: Quasi Peak/average  
\* = QUASI PEAK + = AVERAGE

Start Fr. Hz	Stop Fr. Hz	IF-BW kHz	Detect. Att. dB	Mess.T. s	Trained. type
0.1500	5.0000	10	Peak LD	0.010	
5.0002	30.0000	10	Peak LN	0.010	



POWER LINE POLARITY : NEUTRAL

HYUNDAI  
RFI Voltage Test

E.U.T.1  
Oper. Condition: 5024 N 788 (HFM88,7KHZ, VFM88Hz)  
Operator: GEUN HO, PARK  
Test Spec: GTRP 22 CLASS B

Frequency MHz	Average Peak values dBrV	Peak dBrV	9-peak dBrV	9-peak dBrV	9-peak dBrV
0.1870	49.8	49.4	-19.4	-19.4	-19.4
0.2270	42.8	36.3	-20.3	-20.3	-20.3
0.2840	51.4	45.7	-16.7	-16.7	-16.7
0.3010	48.9	34.7	-26.8	-26.8	-26.8
0.3180	42.4	37.9	-21.9	-21.9	-21.9
0.2880	38.4	31.1	-27.2	-27.2	-27.2
0.2880	44.1	40.3	-17.7	-17.7	-17.7
0.3280	43.3	38.5	-19.8	-19.8	-19.8
Frequency MHz	Average Peak values dBrV	Peak dBrV	Average dBrV	Average dBrV	Average dBrV
0.1800	44.9	29.6	-28.4	-28.4	-28.4
0.1870	48.8	36.3	-16.3	-16.3	-16.3
0.1840	42.4	21.1	-34.1	-34.1	-34.1
0.2270	42.8	20.1	-32.5	-32.5	-32.5
0.2840	51.4	40.3	-12.1	-12.1	-12.1
0.2410	37.4	20.1	-32.1	-32.1	-32.1
0.2870	38.4	18.1	-38.3	-38.3	-38.3
0.3040	42.7	20.8	-29.0	-29.0	-29.0
0.3110	48.9	38.2	-11.8	-11.8	-11.8
0.1880	42.4	23.9	-26.9	-26.9	-26.9
0.2740	34.8	10.8	-37.8	-37.8	-37.8
0.2810	38.4	18.6	-35.8	-35.8	-35.8
0.2880	44.1	36.9	-12.3	-12.3	-12.3
0.3050	43.3	31.0	-16.0	-16.0	-16.0
0.4210	87.6	8.8	-38.8	-38.8	-38.8
0.4280	30.0	9.6	-37.2	-37.2	-37.2
0.4620	34.8	28.1	-18.8	-18.8	-18.8
0.4720	38.7	27.9	-18.7	-18.7	-18.7
0.5420	28.0	18.7	-28.7	-28.7	-28.7
0.5480	31.6	22.6	-22.6	-22.6	-22.6

LINEAR

POWER LINE POLARITY : NEUTRAL

REPORT NO : HEI-RF-20000401

FCC ID : CKLHLM-1500A1

DATE : APR 4,2000

## 4.2 Radiated Emissions Tests

The following table shows the highest levels of Radiated Emissions on both polarization of horizontal and vertical.

Humidity Level : 20 % Temperature : 16

Limit apply to : CISPR 22

Type of Tests : CLASS B

Date : MAR. 27, 2000

Result : PASSED BY -4.5 dB

EUT : 15" COLOR MONITOR

Operating Condition : 1024 X 768 Non-Interlaced (Hf : 68.7 kHz, Vf : 85 Hz)

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

Radiated Emissions		Ant.	Correction Factors	Total	CISPR 22	
Freq. (MHz)	Ampl. (dBuV)	Pol.	Antenna & Cable Loss (dB/m)	Ampl. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
37.0	7.6	V	16.1	23.7	30.0	-6.3
43.7	8.8	V	14.0	22.8	30.0	-7.2
49.4	8.5	V	12.5	21.0	30.0	-9.0
55.5	10.4	V	10.6	21.0	30.0	-9.0
61.7	13.6	V	8.9	22.5	30.0	-7.5
74.1	14.1	V	7.2	21.3	30.0	-8.7
113.8	9.1	V	13.5	22.6	30.0	-7.4
135.8	9.4	V	16.0	25.4	30.0	-4.6
135.8	6.0	H	16.0	22.0	30.0	-8.0
167.0	4.1	V	18.3	22.4	30.0	-7.6
167.0	1.8	H	18.3	20.1	30.0	-9.9
198.0	5.4	V	20.1	25.5	30.0	-4.5
228.3	1.9	H	20.1	23.0	30.0	-7.0
256.4	6.5	V	21.1	27.6	37.0	-9.4
256.4	4.4	H	21.1	25.5	37.0	-11.5

**NOTE:**

- 1.All video modes and resolutions were investigated and the worst-case emissions are reported.
- 2.Other video modes & resolution were tested and found to be in compliance.

Measured by : KEUN HO, PARK / Engineer

Date : MAR. 27. 2000

## 5. 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:**

$$\mathbf{FS = RA + AF + CF}$$

**where FS = Field Strength**

**RA = Receiver Amplitude**

**AF = Antenna Factor**

**CF = Cable Attenuation Factor**

**Assume a receiver reading of 21.5 dBuV is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The 30 dBuV/m value was mathematically converted to its corresponding level in uV/m.**

$$\mathbf{FS = 21.5 + 7.4 + 1.1 = 30 \text{ dBuV/m}}$$

$$\mathbf{\text{Level in uV/m} = \text{Common Antilogarithm} [(30 \text{ dBuV/m})/20] = 31.6 \text{ uV/m}}$$