

## Nemko Korea Co., Ltd.

300-2, Osan-Ri, Mohyun-Myeon, Cheoin-Gu, Yongin-City, Gyeonggi-Do, Korea

TEL:+82 31 322 2333

FAX:+82 31 322 2332

### FCC EVALUATION REPORT FOR CERTIFICATION

**Applicant :**

D&amp;T Inc.

Daedeok Valley, 59-9, Jang Dong, Yuseong Gu,

Daejeon, 305-343 Korea

Attn : Mr. W. W. Lee

Dates of Issue : September 24, 2008

Test Report No. : NK08E709

Test Site : Nemko Korea Co., Ltd.

EMC site, Korea

FCC ID

**THCFS-S2201F**

Brand Name

**TANDBERG**

Contact Person

**D&T Inc.****Daedeok Valley, 59-9, Jang Dong, Yuseong Gu,****Daejeon, 305-343 Korea****Mr. W. W. Lee****Telephone No. : + 82 42 360 0820**

Applied Standard:

Part 15 &amp; 2

Classification :

FCC Class B Device

EUT Type:

22" Color TFT LCD Monitor

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2003.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best 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 : J. H. Ko

Engineer



Reviewed By : D.H. Ryu

Manager &amp; Chief Engineer

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## SCOPE

*Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.*

Responsible Party :	D&T Inc.
Contact Person :	Mr. W. W. Lee
	Tel No.: + 82 42 360 0820
Manufacturer :	D&T Inc.
	Daedeok Valley, 59-9, Jang Dong, Yuseong Gu, Daejeon, 305-343 Korea
Factory :	D&T Inc.
	Daedeok Valley, 59-9, Jang Dong, Yuseong Gu, Daejeon, 305-343 Korea

- FCC ID: THCFS-S2201F
- Model: FS-S2201F
- EUT Type: 22" Color TFT LCD Monitor
- Electric Rating: d.c. 24 V, 5.42 A
- Test Voltage: a.c. 120 V, 60 Hz
- Port/Connector: HDMI x 2 EA, RS232C x 1 EA, USB x 1 EA
- Classification: FCC Class B
- Applied Standard: FCC Part 15 & Part 2
- Test Procedure(s): ANSI C63.4 (2003)
- Dates of Test: September 02, 2008 to September 23, 2008
- Place of Tests: Nemko Korea Co., Ltd. EMC Site
- Test Report No.: NK08E709

## INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2003) was used in determining radiated and conducted emissions emanating from **D&T Inc.**

FCC ID : **THCFS-S2201F, 22" Color TFT LCD Monitor.**

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory.**

The site address is 300-2, Osan-Ri, Mohyun-Myeon, Cheoin-Gu, Yongin-City, Gyeonggi-Do, KOREA

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 kilometers (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 kilometers (18miles) south-southeast from central Seoul.

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 2003.



Nemko Korea Co., Ltd.  
OPEN AREA TEST SITE  
300-2, Osan-Ri, Mohyun-Myeon,  
Cheoin-Gu, Yongin-City, Gyeonggi-Do,  
KOREA, 449-852  
Tel)+ 82 31 322 2333  
Fax)+ 82 31 322 2332

Fig. 1. The map above shows the Seoul in Korea vicinity area.  
The map also shows Nemko Korea Corporation Ltd. EMC Lab and Incheon Airport.

## TEST CONDITIONS & EUT INFORMATION

### Operating During Test

The EUT was connected to the PC and it displayed continuously an “H” pattern on the screen.  
The EUT was set to 1920 x 1200 video resolution, with 60 Hz vertical refresh rate.

### Support Equipment

22" Color TFT LCD Monitor (EUT)	D&T Inc. FCC ID : THCFS-S2201F 1.5 m shielded HDMI cable 1.6 m shielded USB cable Adaptor : Li Shin International Enterprise Corp. Model: 0227B24130 1.2 m unshielded AC cable, 1.3 m Shielded DC cable with 2 ferrite cores at DC jack end and adaptor end.	S/N: N/A  S/N : A30809107397
PC	DELL. Model : VOSTRO220S 1.6 m unshielded AC power cable	FCC DOC  S/N: N/A
Keyboard	HEWLETT PACKARD COMPANY. Model : C4744-60201(KB-9970) 1.6 m unshielded Din cable	FCC DOC  S/N: 1B02800026B
USB Mouse	Suzhou Logitech Electronics Co., Ltd. Model : M-UR69 1.5 m unshielded USB cable	FCC DOC  S/N: N/A
Serial Mouse	ALL SPIRIT CO., LTD. Model : WS-V1-400 1.6 m unshielded serial cable	FCC DOC  S/N: B050402
Printer	HP Model : C6429A 1.5 m shielded parallel cable 1.8 m unshielded AC power cable	FCC DOC  S/N: N/A

## EUT Information

Clock	27.00 MHz (Y1), 28.322 MHz(Y2)
Chipset(s)	U1(24LC21A), U2(24LC21A), U3(SIL9185)
LCD Panel Type	TFT Active matrix
Screen size	22 inch (Diagonal)
Maximum Resolution	1920 x 1200 @ 60 Hz
Pixel pitch	0.247 (H) mm x 0.247 (V) mm
Display colors	16.7 M (RGB 8-bit data)
Contrast Ratio(Typ.)	1200:1
Viewing Angle(CR ≥ 10, Typ.)	89/89/89/89
Response Time(Typ.)	16 ms
Luminance(Typ.)	300 cd/m2
Synchronization	Horizontal Frequency : 70 kHz
	Vertical Frequency : 85 kHz
Power Consumption	Maximum : 90 W
	Standby mode : under 30 W
Port(s)	HDMI x 2 EA, RS232C x 1 EA, USB x 1 EA
Size and weight	508.4 (W) x 338.7 (H) x 85.5 (D) : mm / 7.1 kg
Power	Adaptor : a.c. 100-240 V, 50-60 Hz, 2 A Max
	Monitor : d.c. 24 V, 5.42 A Max

## EUT System

Equipment	Model	Manufacturer	Serial Number
LCD Panel	LTM220CS01	Samsung Electronics	N/A
LCD Board	LTM220CS01C4L	N/A	N/A
Main Board	LB507 MAIN BOARD	CID	N/A
Inverter Board	AT-6220U	P.I.S Corp.	N/A
USB Controller Board	EXII-7710UC	3M touch systems	N/A
AC/DC Adaptor	0227B24130	Li Shin Electronic Co., Ltd.	A30809107397

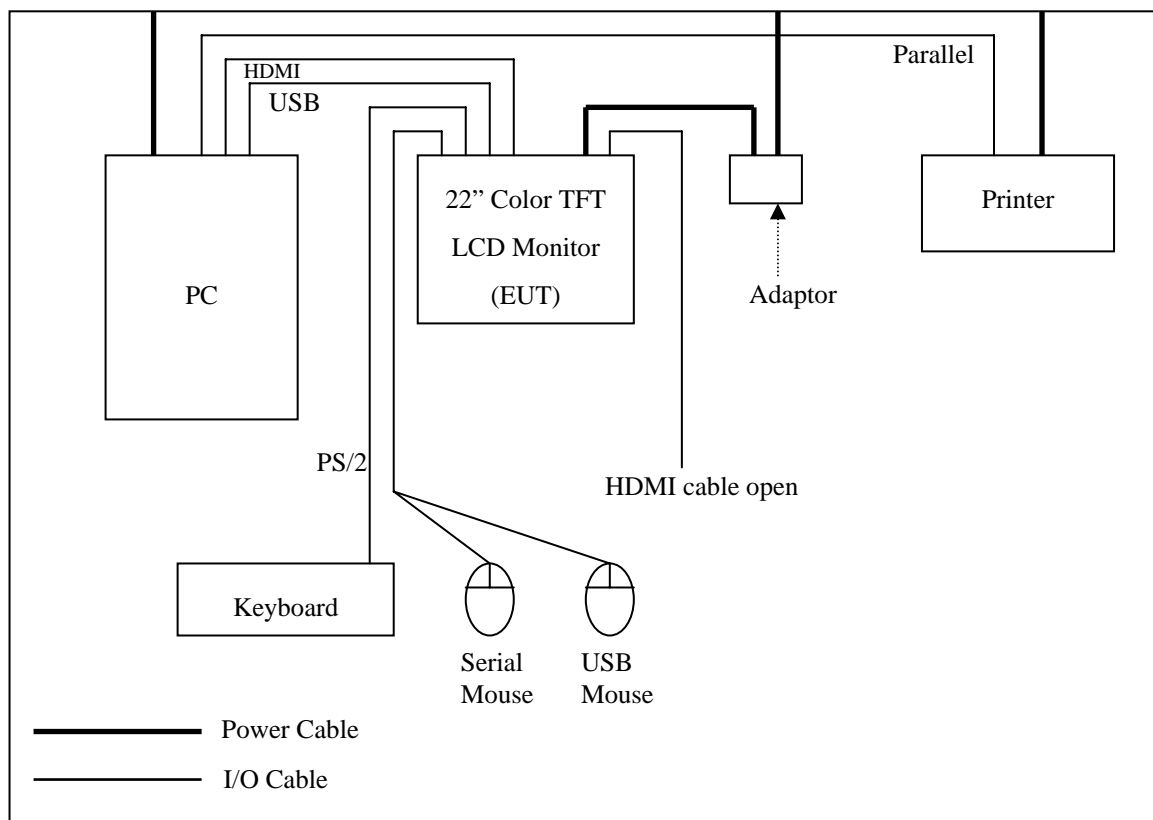
## Description of Test Modes

The EUT was pre-tested under the following resolutions mode:

1. 800 X 600 (75 Hz / 46.875 kHz) : Clock 49.5 MHz
2. 1400 X 1050 (60 Hz / 65.317 kHz) : Clock 121.751 MHz
3. 1920 X 1200 (60 Hz / 74 kHz) : Clock 153.999 MHz

The worst emission level was found when the EUT was tested under 1920 x 1200 resolution, therefore, the test data of this mode was recorded in the report.

## Setup Drawing



## SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	Paragraph No.	Result	Remark
Conducted Emission	15.107(a)	Complies	
Radiated Emission	15.109(a)	Complies	Below 1 GHz
Radiated Emission	15.109(a)	Complies	Above 1 GHz

## RECOMMENDATION/CONCLUSION

The data collected shows that the **D&T Inc.**

FCC ID : **THCFS-S2201F, 22" Color TFT LCD Monitor.**

The highest emission observed was at **0.15 MHz** for conducted emissions with a A.V margin of **10.8 dB**, at **771.44 MHz** for radiated emissions with a margin of **3.5 dB**.

## SAMPLE CALCULATION

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

$$\mu V = 10^{(\text{dB } \mu V/20)}$$

### EX. 1.

@57.7 MHz

Class B limit = 100  $\mu V/m$  = 40.0 dB  $\mu V/m$

Reading = 19.1 dB  $\mu V$  (calibrated level)

Antenna factor + Cable Loss = 10.12 dB

Total = 29.22 dB  $\mu V/m$

Margin = 40.0 - 29.22 = 10.78

10.78 dB below the limit



## DESCRIPTION OF TESTS

### Conducted Emissions

The Line conducted emission test facility is located inside a 4 X 7 X 2.5 m shielded enclosure.

It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6.

A 1 m X 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 0.5 m away from the side of wall of the shielded room

Rohde & Schwarz (ESH3-Z5) and Kyoritsu (KNW-407) of the 50 ohm / 50 uH Line Impedance Stabilization Network(LISN) are bonded to the shielded room.

The EUT is powered from the Rohde & Schwarz LISN and the support equipment is powered from the Kyoritsu LISN. Power to the LISN s are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1/2".

If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs,

All interconnecting cables more than 1 m were shortened by non inductive bundling (serpentine fashion) to a 1 m length.

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 spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 20 ms sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCS30).

The detector function were set to CISPR quasi-peak mode & average mode.

The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; which ever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

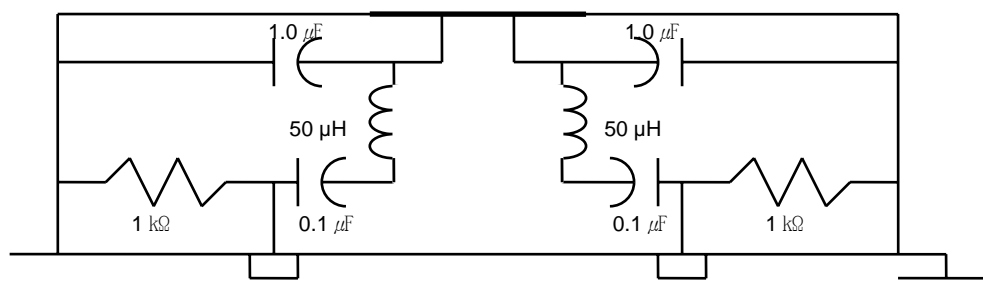


Fig. 2. LISN Schematic Diagram

## DESCRIPTION OF TESTS

### Radiated Emissions

Preliminary measurement were made indoors at 3 meter using broad band antennas, broadband amplifier, and spectrum analyzer 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, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna was note for each frequency found. The spectrum was scanned from 30 to 1000 MHz using Biconical log Antenna(ARA, LPB-2520/A).Above 1 GHz, Double Ridged Broadband Horn Antenna (SCHWARTZBECK, BBHA9120D) was used.

Final Measurements were made outdoors at 3 m or 10 m test range using Trilog-Broadband Antenna (Shwarzbeck, VULB9168) or Double Ridged Broadband Horn Antenna (SCHWARTZBECK, BBHA9120D). The test equipment was placed on a wooden table.

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 EMI test receiver. (ESCS30)

The detector function were set to CISPR quasi-peak and peak mode and the bandwidth of the receiver were set to 120 kHz and 1 MHz depending on the frequency or type of signal. The half wave dipole antenna was tuned to the frequency found during preliminary radiated measurements.

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

The EUT, support equipment and interconnecting cables were re-arranged and manipulated to maximize each EME emission.

The turn table containing the Technology 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 : switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; which ever determined the worst case emission.

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

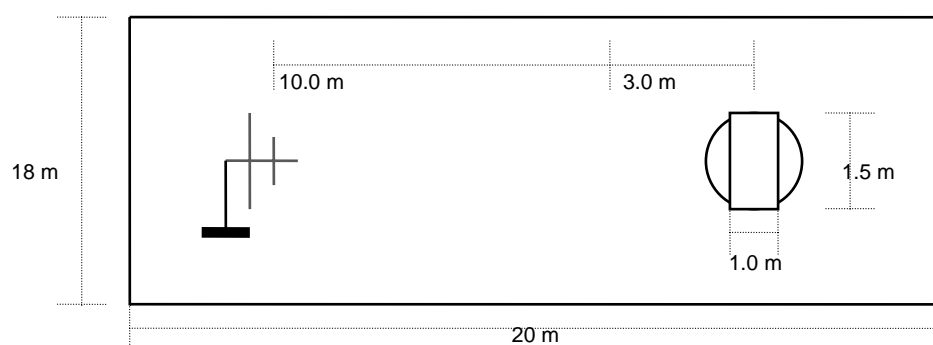


Fig. 3. Dimensions of Outdoor Test Site

## TEST DATA

### Conducted Emissions

FCC ID : THCFS-S2201F

Frequency (MHz)	Level(dB $\mu$ V)		Line	Limit(dB $\mu$ V)		Margin(dB)	
	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.15	55.2	39.6	L	66.0	56.0	10.8	16.4
0.17	52.2	38.4	L	65.0	55.0	12.8	16.6
0.21	46.4	35.3	L	63.2	53.2	16.8	17.9
0.42	39.9	28.1	N	57.4	47.4	17.5	19.3
1.25	35.2	21.5	L	56.0	46.0	20.8	24.5
1.37	34.8	25.9	N	56.0	46.0	21.2	20.1

Table 1. Line Conducted Emissions Tabulated Data

#### NOTES:

1. Measurements using CISPR quasi-peak mode & average mode.
2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.
3. LINE : L =Line , N = Neutral
4. The limit for Class B device is on the FCC Part section 15.107(a).



Tested by : J. H. Ko

## TEST DATA

### Radiated Emissions

FCC ID : THCFS-S2201F

#### ► 30 MHz ~ 1 GHz

Frequency (MHz)	Reading (dB $\mu$ V/m)	Pol* (H/V)	AF+CL+Amp (dB)**	Result (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
115.29	44.0	V	-13.2	30.8	43.5	12.7
153.92	43.1	V	-9.3	33.8	43.5	9.7
173.30	45.3	V	-11.1	34.2	43.5	9.3
462.86	47.0	H	-6.1	40.9	46.0	5.1
771.44	42.1	V	0.4	42.5	46.0	3.5
799.66	39.7	H	0.5	40.2	46.0	5.8
925.72	37.8	H	3.2	41.0	46.0	5.0

Table 2. Radiated Measurements at 3 meters (1920 x 1200, 60 Hz)

#### ► 1 GHz ~ 2 GHz

Frequency (MHz)	Reading (dB $\mu$ V)		Pol* (H/V)	AF+CL+Amp (dB)**	Limit (dB $\mu$ V/m)		Final Result (dB $\mu$ V/m)	
	Peak	Average			Peak	Average	Peak	Average
1135.00	53.0	***)	H	-6.5	74.0	54.0	46.5	-
1500.00	59.2	44.1	H	-5.3	74.0	54.0	53.9	38.8
1593.00	51.7	***)	H	-5.2	74.0	54.0	46.5	-
1907.00	49.9	***)	V	-3.8	74.0	54.0	46.1	-
1928.00	51.5	***)	V	-3.7	74.0	54.0	47.8	-

NOTES : Measurements using peak mode & average mode.

Table 3. Radiated Measurements at 3 meters (1920 x 1200, 60 Hz)

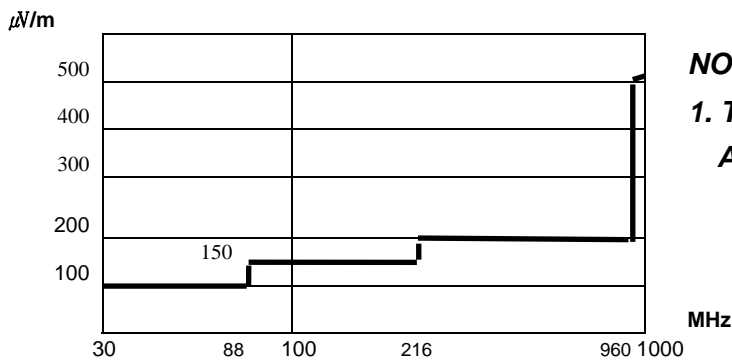


Fig. 4. Limits at 3 meters

#### NOTES:

1. The radiated limits are shown on Figure 5.  
Above 1 GHz the limit is 500  $\mu\text{V/m}$ .

#### NOTES:

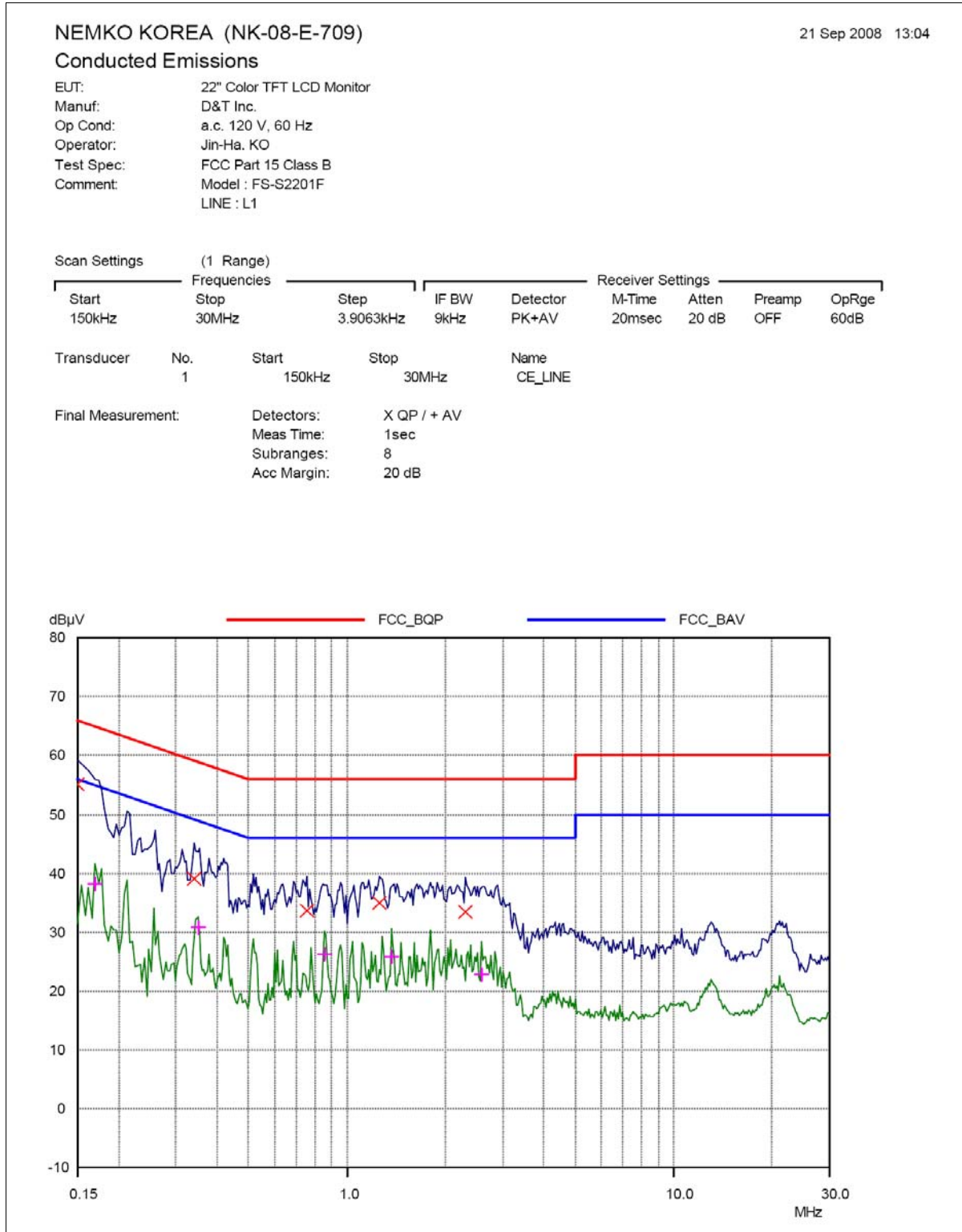
1. \*Pol. H=Horizontal V=Vertical
2. \*\*AF+CL+Amp. = Antenna Factor + Cable Loss + Amplifier.
3. \*\*\* average limit is met when using a peak detector receiver, the EUT was deemed to meet both limits and measurement with the average detector receiver is unnecessary.
4. The limit for Class B device is on the FCC Part section 15.109(a).
5. All modes of operations were investigated and the worst -case emission was reported.
6. Above 1 GHz, peak detector function mode is used using a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz, average detector function mode is used using a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.  
Peak mode is used with linearly polarized horn antenna and low-loss microwave cable.



Tested by : J. H. Ko

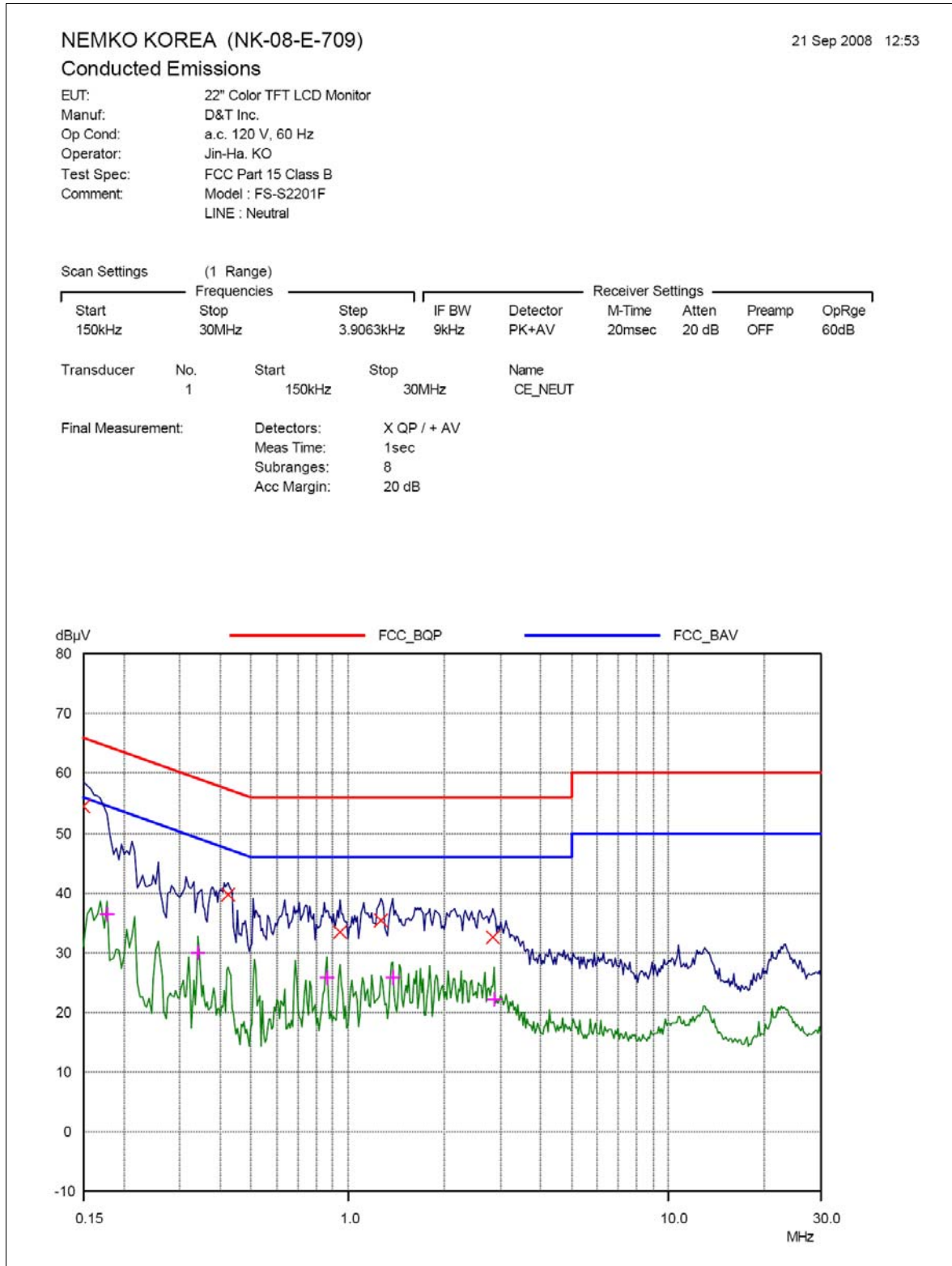
## PLOTS OF EMISSIONS

- Conducted Emission at the Mains port (Line)



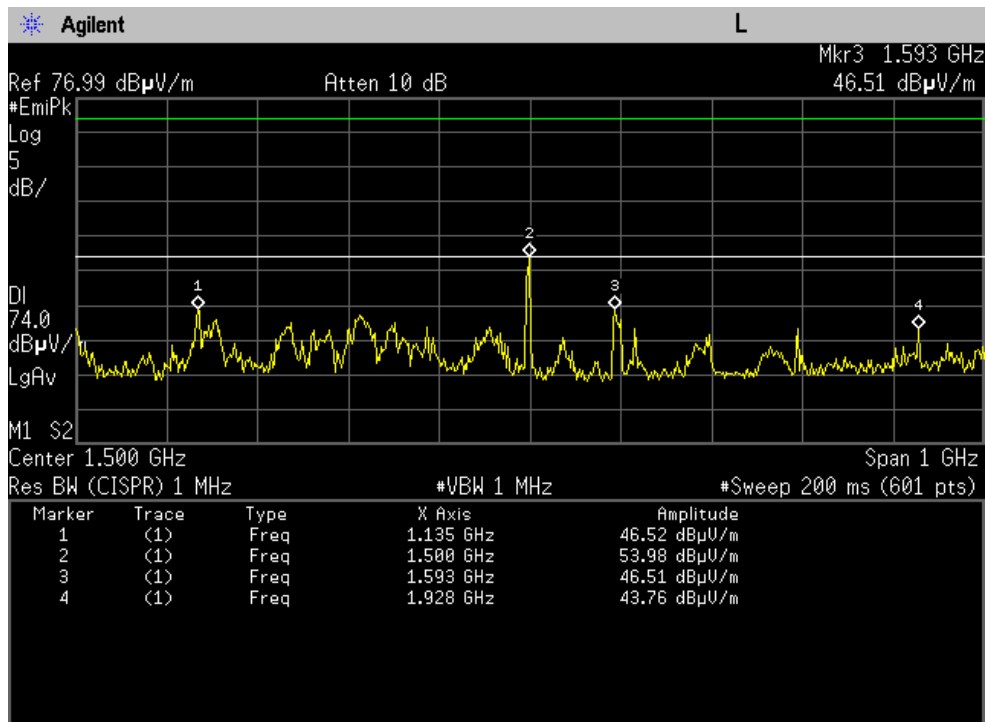
## PLOTS OF EMISSIONS

- Conducted Emission at the Mains port (Neutral)

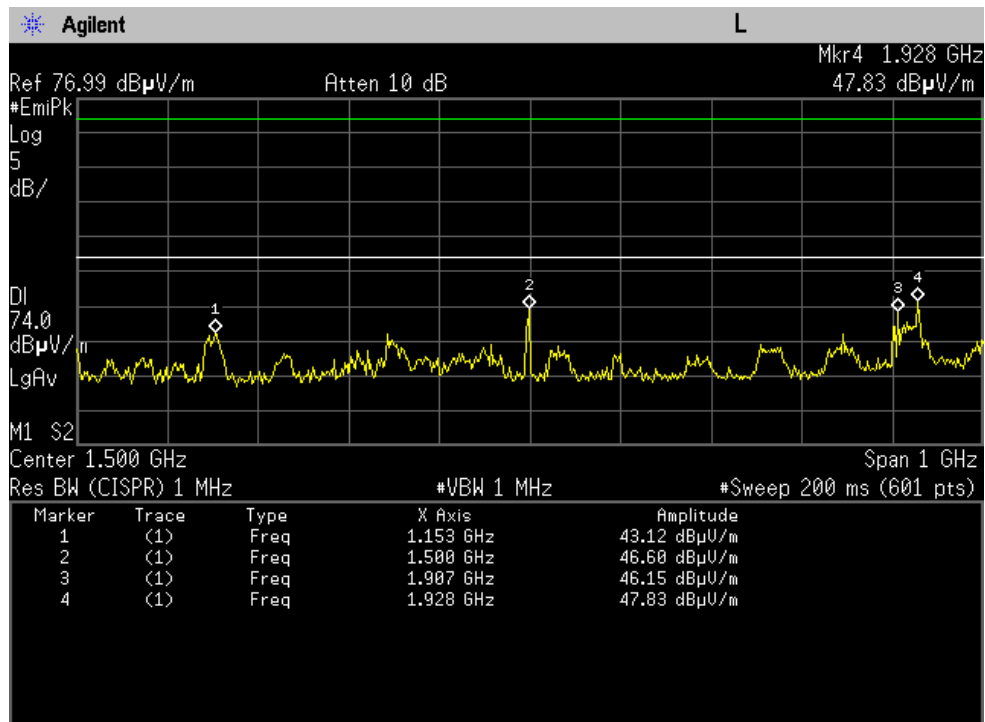


## PLOTS OF EMISSIONS

- Radiated Emission (Above 1 GHz)**



[Horizontal]



[Vertical]



## ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 with the confidence level of 95 %

### 1. Radiation Uncertainty Calculation

<i>Contribution</i>	<i>Probability Distribution</i>	<i>Uncertainty(+/-dB)</i>
Antenna Factor	Normal ( $k = 2$ )	$\pm 0.5$
Cable Loss	Normal ( $k = 2$ )	$\pm 0.04$
Receiver Specification	Rectangular	$\pm 2.0$
Antenna directivity	Rectangular	$\pm 1.0$
Antenna Factor variation with Height		
Antenna Phase Center Variation		
Antenna Factor Frequency Interpolation		
Measurement Distance Variation		
Site Imperfections	Rectangular	$\pm 2.0$
Mismatch:Receiver VRC $r_i=0.3$ Antenna VRC $r_R=0.1(B_i)0.4(L_p)$ Uncertainty Limits $20\log(1+/-r_i r_R)$	U-Shaped	$+ 0.25 / - 0.26$
System Repeatibility	Std.deviation	$\pm 0.05$
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	$\pm 1.77$
Expended Uncertainty U	Normal ( $k = 2$ )	$\pm 3.5$

### 2. Conducted Uncertainty Calculation

<i>Contribution</i>	<i>Probability Distribution</i>	<i>Uncertainty(+/-dB)</i>
Receiver Specification	Normal ( $k = 2$ )	$\pm 2.0$
LISN coupling spec.	Normal ( $k = 2$ )	$\pm 0.4$
Cable and input attenuator cal.	Rectangular	$\pm 0.4$
Mismatch:Receiver VRC $r_i=0.3$ LISN vrc $r_g=0.1$ Uncertainty Limits $20\log(1+/-r_i r_R)$	U-Shaped	$\pm 0.26$
System Repeatibility	Std.deviation	$\pm 0.68$
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	$\pm 1.18$
Expended Uncertainty U	Normal ( $k = 2$ )	$\pm 2.4$

## LIST OF TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESCS 30	833364/020	Apr. 01 2008	1year
2	*Test Receiver	R & S	ESCS 30	100302	Dec. 03 2007	1year
3	*Amplifier	HP	8447F	2805A03427	Apr. 07 2008	1year
4	Amplifier	HP	8447F	2805A03351	Oct. 23 2007	1year
5	*Amplifier	HP	8447F	2805A03406	Apr. 17 2008	1year
6	*Pre Amplifier	HP	8449B	3008A00107	Feb. 27 2008	1year
7	*Spectrum Analyzer	Advantest	R3265A	45060401	Dec. 04 2007	1year
8	*Spectrum Analyzer	Agilent	E4440A	MY44022567	Dec. 04, 2007	1year
9	Spectrum Analyzer	HP	8566B	2607A03469	Feb. 27 2008	1year
10	Loop Antenna	EMCO	EMCO/6502	8911-2436	Dec. 13 2007	1year
11	Biconical Log Antenna	ARA	LPB-2520/A	1180	Apr. 21 2008	1year
12	*Biconical Log Antenna	ARA	LPB-2520/A	1209	Dec. 31 2007	1year
13	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9168	9168-257	Apr. 21 2008	1year
14	*Double Ridged Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-474	June. 13 2008	1year
15	Signal Generater	R & S	SMP02	833286/003	Aug. 07 2008	1year
16	*LISN	R & S	ESH3-Z5	833874/006	Oct. 23 2007	1year
17	*LISN	Kyoritsu	KNW-407	8-1034-10	Feb. 27 2008	1year
18	*Position Controller	DAEIL EMC	N/A	N/A	N/A	N/A
19	*Turn Table	DAEIL EMC	N/A	N/A	N/A	N/A
20	*Antenna Mast	DAEIL EMC	N/A	N/A	N/A	N/A
21	*Anechoic Chamber	EM Eng.	N/A	N/A	N/A	N/A
22	*Shielded Room	EM Eng.	N/A	N/A	N/A	N/A
23	*Position Controller	Seo-Young EMC	N/A	N/A	N/A	N/A
24	*Turn Table	Seo-Young EMC	N/A	N/A	N/A	N/A
25	*Antenna Mast	Seo-Young EMC	N/A	N/A	N/A	N/A
26	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
27	*Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A

\*) Test equipment used during the test

## ***APPENDIX D – BLOCK DIAGRAM***

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## ***APPENDIX E – USER’S MANUAL***

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## ***APPENDIX F – SCHEMATIC DIAGRAM***

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