

## ***Nemko Korea Co., Ltd.***

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**Applicant :****Dooyang Systems Inc.****SK Techno Bldg. 7th Floor (Suite #707) 16-4,****Sungsoo-1Ga, 2-Dong, Sungdong-Ku, Seoul, 133-710,****Korea****Attn : Mr. Ki-Woong. Eom****Dates of Issue : April 18, 2005****Test Report No. : NK2FE065****Test Site : Nemko Korea Co., Ltd.****EMC site, Korea****FCC ID*****S6DTX-2M*****Contact Person****Dooyang Systems Inc.****SK Techno Bldg. 7th Floor (Suite #707) 16-4,****Sungsoo-1Ga, 2-Dong, Sungdong-Ku, Seoul,****133-710, Korea****Mr. Ki-Woong. Eom****Telephone No. : +82 2 489 2612**

Applied Standard:

Part 15 &amp; 2

Classification :

FCC Class B Device

EUT Type:

TFT-LCD Monitor

The device bearing the brand name and FCC ID 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 : C. S. Choi****Engineer****Reviewed By : H.H. Kim****Manager & 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.*

<b>Responsible Party :</b>	Dooyang Systems Inc.
<b>Contact Person :</b>	Mr. Ki-Woong. Eom Tel No.: +82 2 489 2612
<b>Manufacturer :</b>	Dooyang Systems Inc. SK Techno Bldg. 7th Floor (Suite #707) 16-4, Sungsoo-1Ga, 2-Dong, Sungdong-Ku, Seoul, 133-710, Korea
<b>Factory :</b>	Dooyang Systems Inc. SK Techno Bldg. 7th Floor (Suite #707) 16-4, Sungsoo-1Ga, 2-Dong, Sungdong-Ku, Seoul, 133-710, Korea

- FCC ID: S6DTX-2M
- Model: TX-2M
- EUT Type: TFT-LCD Monitor
- Electric Rating: Input : 100-240Vac, 50-60Hz, 1.0A  
Output : +12Vdc, 6.67A
- Port/Connector: Video DVI-D Connector, 4 USB Connector
- Classification: FCC Class B
- Applied Standard: FCC Part 15 & Part 2
- Test Procedure(s): ANSI C63.4 (2003)
- Dates of Test: March 29, 2005 to April 07, 2005
- Place of Tests: Nemko Korea Co., Ltd. EMC Site
- Test Report No.: NK2FE065

## 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 C63.4-2001) was used in determining radiated and conducted emissions emanating from **Dooyang Systems Inc.**

FCC ID : **S6DTX-2M, TFT-LCD Monitor.**

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

The site address is 300-2, Osan-Ri, Mohyun-Myun, Yongin-City, Kyungki-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 C63.4-2003.

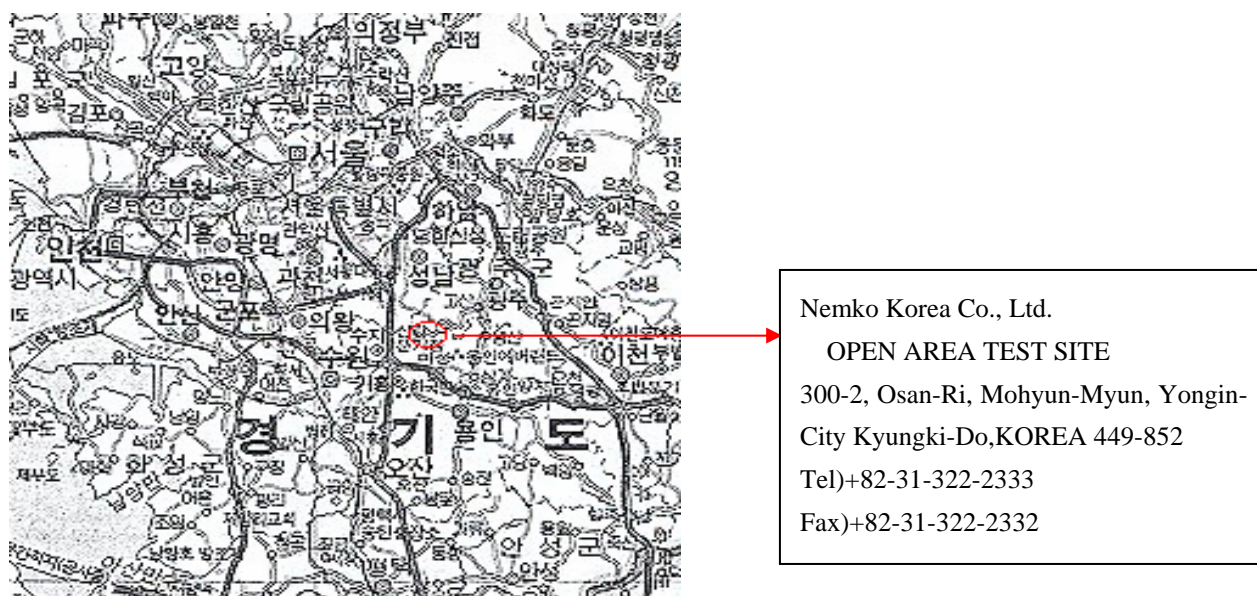


Fig. 1. The map above shows the Seoul in Korea vicinity area.  
The map also shows Nemko Korea Corporation Ltd. EMC Lab and Incheon Airport.

## 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 1600 x 1200 video resolution, with 60Hz vertical refresh rate.

### Support Equipment

TFT-LCD Monitor (EUT)	Dooyang Systems Inc., FCC ID: S6DTX-2M 1.0m Unshielded DC power cable 1.5m Shielded DVI-D cable	S/N : N/A
Adaptor	Ault Inc., Model : MW116 1.2m Shielded USB cable 1.5m Unshielded AC power cable	S/N : N/A
Computer	Dell Computer Corporation, Model : DHM (Dimension 4550) 1.5m Unshielded AC power cable	S/N : N/A
Keyboard	Solid Year Co., Ltd., Model : POWER KEYBOARD ACK-260 1.5m Unshielded Din cable	S/N : 910044844
PS/2 Mouse	Microsoft Corporation, Model : X06-08477 1.5m Unshielded Din cable	S/N : N/A
USB Mouse	Dell Computer Corporation, Model: M-UVDEL1 1.5m Shielded USB cable	S/N : LNA44003753
Serial Mouse	IO.Tec, Model : LASER MOUSE 1.7m Shielded D-Sub cable	S/N : N/A
Printer	HP, Model: C5870A 1.8m Shielded Parallel cable	S/N : SG88R131GW
Adaptor	YOKOGAWA, Model : C4557-60104 1.8m Unshielded AC power cable	S/N : N/A
VGA(Video) Card	Rea/Vision VR Engine/MD Model : CMD2W00236074	S/N : N/A

## **EUT Information**

Clock	14.31818MHz(Y1), 12MHz(Y2)
Chipset(s)	U1(Sil161), U4A/U4B/U4C/U4D/U4E (PW166B), U15(DC90C387), U19(KC82C160)
Horizontal Frequency	75kHz
Vertical Frequency	60Hz
Support resolution	1600 x 1200
Port(s)	Video DVI-D Connector, 4USB Connector

## **EUT System**

Equipment	Model	Manufacturer	Serial Number
Main Board	TX2M	Dooyang Systems Inc.	N/A
Inverter Board	GH070A	Green C&C Tech	N/A
OSD Board	2002/11/24	Dooyang Systems Inc.	N/A
LCD Panel	NL160120BM27-03	NEC LCD Technologies, Ltd.	ES4410001
Adaptor	MW116	Ault Inc.	N/A

## **EUT Modification**

Modification 1	Modified the metal chassis part with shield tape.
Modification 2	Added gasket on I/O port of main board.
Modification 3	Added ferrite core at OSD cable.
Modification 4	Added gasket to contact between LCD back panel and main chassis.

► See the Appendix D

## SUMMARY OF TEST RESULTS

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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(g)	Complies	Below 1GHz
Radiated Emission	15.109(a)	Complies	Above 1GHz

## RECOMMENDATION/CONCLUSION

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The data collected shows that the **Dooyang Systems Inc.**

FCC ID : **S6DTX-2M, TFT-LCD Monitor.**

The highest emission observed was at **0.73 MHz** for conducted emissions with a A.V margin of **3.9 dB**, at **162.92 MHz** for radiated emissions with a margin of **1.5 dB**.

## SAMPLE CALCULATION

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

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

### EX. 1.

@165.0 MHz

Class B limit = 30.0 dB  $\mu V/m$

Reading = 38.2 dB  $\mu V$  (calibrated level)

Antenna factor + Cable Loss + Amplifier Gain = -12.9 dB

Total = 25.30 dB  $\mu V/m$

Margin = 30.0 – 25.30 = 4.70

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

Rohde & Schwarz (ESH3-Z5) and Kyoritsu (KNW-407) of the 50ohm/50uH 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 meter were shortened by non inductive bundling (serpentine fashion) to a 1 meter 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 150kHz to 30MHz with 20msec 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 9KHz. 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.

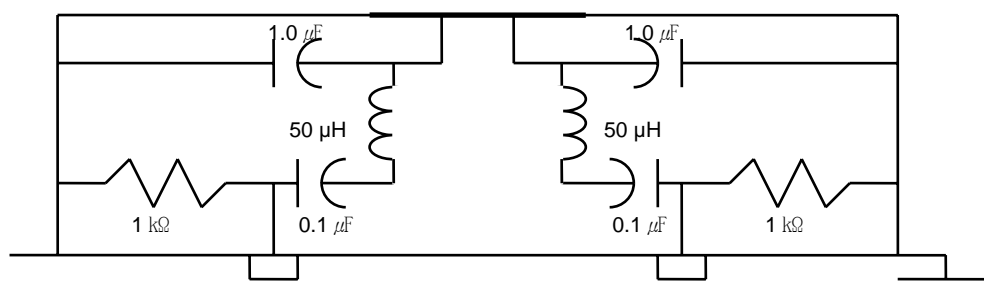


Fig. 2. LISN Schematic Diagram



## 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 1000MHz using Biconical log Antenna(ARA, LPB-2520/A). Above 1GHz, Doppels Teg Horn antenna (EMCO, DAA-37121) was used.

Final Measurements were made outdoors at 3 or 10m test range using Logbicon Super Antenna(ARA, LPB-2520/A) or Doppels Teg Horn antenna (EMCO, DAA-37121)

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 120KHz and 1MHz 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 0.8m high non- metallic 1.0X 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 4meter 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.

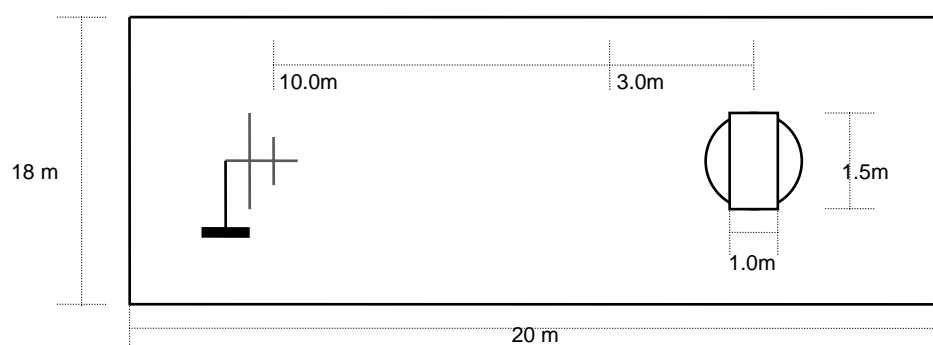


Fig. 3. Dimensions of Outdoor Test Site

## TEST DATA

### Conducted Emissions

FCC ID : S6DTX-2M

Frequency (MHz)	Level(dB $\mu$ V)		Line	Limit(dB $\mu$ V)		Margin(dB)	
	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.52	41.4	41.2	L	56.0	46.0	14.6	4.8
0.73	42.5	42.1	L	56.0	46.0	13.5	3.9
0.84	41.3	40.8	N	56.0	46.0	14.7	5.2
1.05	42.3	41.8	L	56.0	46.0	13.7	4.2
1.16	40.8	40.0	N	56.0	46.0	15.2	6.0
1.47	40.8	40.6	L	56.0	46.0	15.2	5.4

\*) Correction factor was included to Test Level (dB $\mu$ V)

**Table 1. Line Conducted Emissions Tabulated Data (1600 x 1200, 60Hz)**

#### NOTES:

1. Measurements using CISPR quasi-peak mode & average mode.
2. All modes of operations were invested and the worst -case emission was 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 : **C. S. Choi**

## TEST DATA

### Radiated Emissions

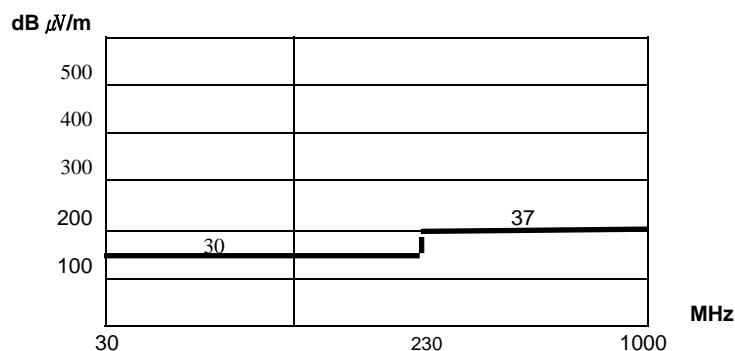
FCC ID : S6DTX-2M

#### ● 30MHz ~ 1GHz

Frequency (MHz)	Reading (dB $\mu$ N)	Pol* (H/V)	AF+CL+Amp (dB)**	Result (dB $\mu$ N/m)	Limit (dB $\mu$ N/m)	Margin (dB)
125.30	43.4	H	-16.5	26.9	30.0	3.1
162.92	41.4	V	-12.9	28.5	30.0	1.5
556.68	36.9	H	-4.8	32.1	37.0	4.9
622.95	37.9	H	-3.0	34.9	37.0	2.1
636.20	33.3	H	-2.6	30.7	37.0	6.3
715.74	34.7	V	-0.5	34.2	37.0	2.8

**NOTES:** Measurements using CISPR quasi-peak mode.

**Table 2. Radiated Measurements at 10meters (1600 x 1200, 60Hz)**



**Fig. 4. Limits at 10 meters**

#### **NOTES:**

- \*Pol.** H=Horizontal V=Vertical
- \*\*AF+CL+Amp.** = Antenna Factor + Cable Loss + Amplifier.
- All modes of operations were investigated and the worst -case emission was reported.**
- The limit for Class B device is on the FCC Part section 15.109(g).**



Tested by : **C. S. Choi**

## TEST DATA

### Radiated Emissions

FCC ID : S6DTX-2M

#### ● 1GHz ~ 2GHz

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
1325.00	61.3	53.7	H	-7.61	74.0	54.0	53.7	46.1
1458.00	57.1	46.5	H	-6.73	74.0	54.0	50.4	39.8
1723.00	58.5	47.1	V	-5.23	74.0	54.0	53.3	41.9
1914.00	56.4	38.2	V	-4.35	74.0	54.0	52.0	33.9
1929.00	56.5	38.5	V	-4.27	74.0	54.0	52.2	34.2
1988.00	62.4	51.2	V	-3.96	74.0	54.0	58.4	47.2

NOTES : Measurements using peak mode & average mode.

Table 3. Radiated Measurements at 3meters (1600 x 1200, 60Hz)

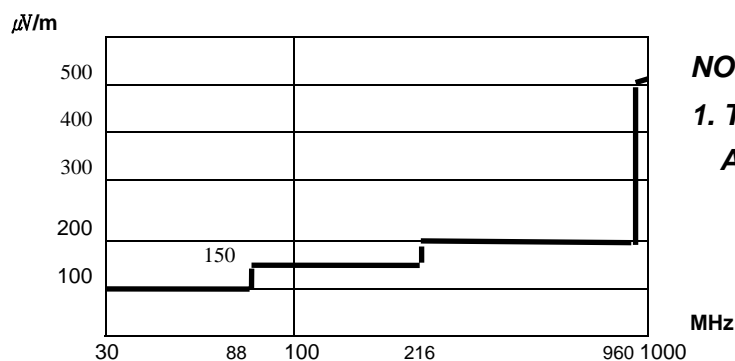


Fig. 5. Limits at 3 meters

#### NOTES:

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

#### NOTES:

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



Tested by : C. S. Choi

**PLOTS OF EMISSIONS**

● **Conducted Emission at the Mains port (Line)**

NEMKO KOREA (NK-2F-E-065)

29 Mar 2005 15:14

Conducted Emissions

EUT: TFT-LCD Monitor

Manuf: Dooyang Systems Inc.

Op Cond: Maximum Resolution (1600 \* 1200 @ 60Hz, 8bit)

Operator: Chang-Soo, Choi

Test Spec: CISPR 22 Class B

Comment: MODEL : TX-2M

Result File: e065l.dat : TX-2M\_FCC

Scan Settings

(1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	10 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	CE_LINE

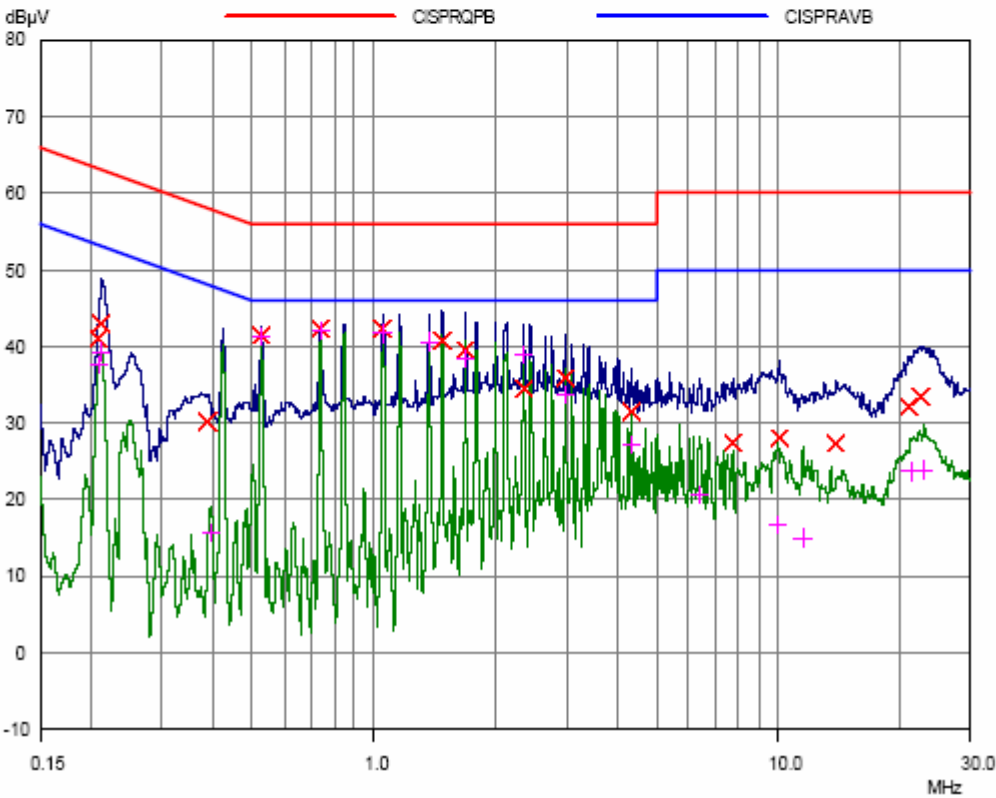
Final Measurement:

Detectors: X QP / + AV

Meas Time: 1sec

Subranges: 16

Acc Margin: 60 dB



**PLOTS OF EMISSIONS**

● **Conducted Emission at the Mains port (Neutral)**

NEMKO KOREA (NK-2F-E-065)

29 Mar 2005 15:30

Conducted Emissions

EUT: TFT-LCD Monitor

Manuf: Dooyang Systems Inc.

Op Cond: Maximum Resolution (1600 \* 1200 @ 60Hz, 8bit)

Operator: Chang-Soo, Choi

Test Spec: CISPR 22 Class B

Comment: MODEL : TX-2M

LINE : NEUTRAL-PE

Result File: e065n.dat : TX-2M\_FCC

Scan Settings

(1 Range)

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	3.9063kHz	9kHz	PK+AV	20msec	10 dB	OFF	60dB

Transducer	No.	Start	Stop	Name
	1	150kHz	30MHz	CE_LINE

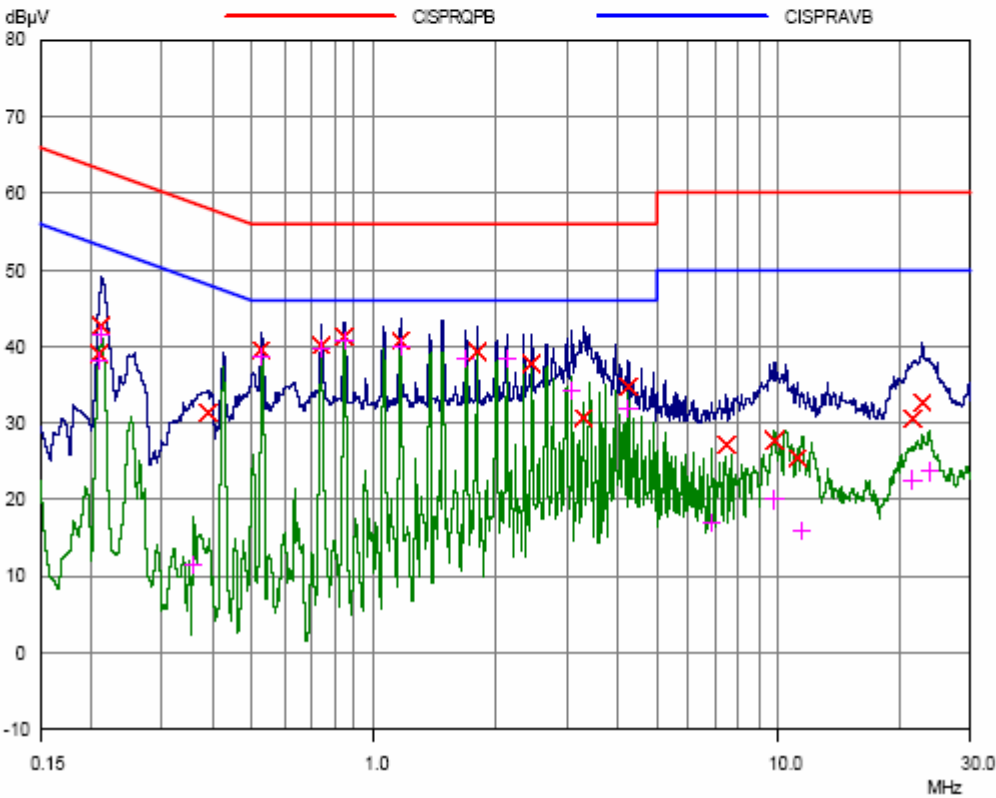
Final Measurement:

Detectors: X QP / + AV

Meas Time: 1sec

Subranges: 16

Acc Margin: 60 dB



# 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

Contribution	Probability Distribution	Uncertainty(+/-dB)
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

Contribution	Probability Distribution	Uncertainty(+/-dB)
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	Calibration Date
1	*Test Receiver	R & S	ESCS 30	2004.08
2	*Test Receiver	R & S	ESCS 30	2004.12
3	*Amplifier	HP	8447F	2004.07
4	*Amplifier	HP	8447F	2005.01
5	Amplifier	HP	8447F	2004.10
6	*Amplifier	HP	8449B	2005.03
7	*Spectrum Analyzer	HP	8566B	2005.03
8	*Spectrum Analyzer	HP	8568B	2004.10
9	*Logbicon Super Antenna	Schwarzbeck	VULB9166	2004.05
10	*Doppels Teg Horn	EMCO	DAA-37121	2004.10
11	Dipole Antenna	R & S	VHA9103	2004.05
12	Dipole Antenna	R & S	UHA9105	2004.05
13	*Biconical Log Antenna	ARA	LPB-2520/A	2004.05
14	High Voltage Probe	R & S	ESH2-Z3	2004.06
15	Signal Generater	R & S	SMP02	2005.03
16	*LISN	R & S	ESH3-Z5	2004.10
17	*LISN	Kyoritsu	KNW-407	2005.03
18	LISN	Kyoritsu	KNW-408	2004.12
19	CDN	FCC	NCD-T4	2004.05
20	CDN	FCC	NCD-T2	2004.05
21	*Position Controller	EM Eng.	N/A	N/A
22	*Turn Table	EM Eng.	N/A	N/A
23	*Antenna Mast	EM Eng.	N/A	N/A
24	*Anechoic Chamber	EM Eng.	N/A	N/A
25	*Shielded Room	EM Eng.	N/A	N/A
26	*Position Controller	Seo-Young EMC	N/A	N/A
27	*Turn Table	Seo-Young EMC	N/A	N/A
28	*Antenna Mast	Seo-Young EMC	N/A	N/A
29	*Anechoic Chamber	Seo-Young EMC	N/A	N/A
30	*Shielded Room	Seo-Young EMC	N/A	N/A

\*) Test equipment used during the test



## ***APPENDIX E – SCHEMATIC DIAGRAM***

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## ***APPENDIX F – USER’S MANUAL***

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## ***APPENDIX G – BLOCK DIAGRAM***

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