





# Nemko Korea Co., Ltd.

300-2, Osan-Ri, Mohyun-Myun, Yongin-City, Kyungki-Do, KOREA

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**Applicant:** 

FCC ID

**Brand Name** 

Contact Person

Daewoo Electronics Corporation. Dates of Issue : May 09, 2005 M/W Oven Div. R&D Center, 412-2, Test Report No. : NK2FE239

Chungchun-Dong, Bupyong-Gu, Incheon, Test Site: Nemko Korea Co., Ltd.

403-032, Korea EMC site, Korea

Attn: Mr. Gun-Woo, Ro

C5F7NF22MO120N

DAEWOO

Daewoo Electronics Corporation.
M/W Oven Div. R&D Center, 412-2,
Chungchun-Dong, Bupyong-Gu, Incheon,
403-032, Korea
Mr. Gun-Woo, Ro
Telephone No.: +82 32 510 7923

Applied Standard: Part 18 & 2

Classification: Consumer ISM equipment

EUT Type: Microwave oven

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 MP-5:1986.

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 : S. H. Baek

Bulk sungblun

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 18.

**Responsible Party:** Daewoo Electronics Corporation.

Contact Person: Mr. Gun-Woo. Ro

Tel No.: +82 32 510 7923

**Manufacturer:** Daewoo Electronics Corporation.

M/W Oven Div. R&D Center, 412-2, Chungchun-Dong,

Bupyong-Gu, Incheon, 403-032, Korea

**Factory:** 1) Daewoo Microwave Oven Co., Ltd.

981-1, Jangduck-Dong, Gwangsan-Gu, Kwangju-Shi,

506-251, Korea

2) Daewoo Electronics Corporation.

Detda, Dagang District, Tianjin, Chaina

FCC ID: C5F7NF22MO120N

Model: KOR-220SBrand Name: DAEWOO

EUT Type: Microwave Oven
 Applied Standard: FCC Part 18 & Part 2

Test Procedure(s): MP-5:1986

Dates of Test: Aril 23, 2005 to April 29,2005
 Place of Tests: Nemko Korea Co., Ltd. EMC Site

Test Report No.: NK2FE239

### **EUT Information**

Electric Rating:	120V, 60Hz AC only, 1.65kW
Clock:	4MHz
Magnetron Type:	RM269 / Daewoo Electronics Corp.
Operating Frequency	2.45GHz
Rated Output Power	1200W



### **INTRODUCTION**

The measurement procedure described in MP5:1986 for Methods of Measurement of radiated, powerline conducted radio noise, frequency and power output was used in determining emissions emanating from **Daewoo Electronics Corporation**.

FCC ID: C5F7NF22MO120N, Microwave Oven.

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

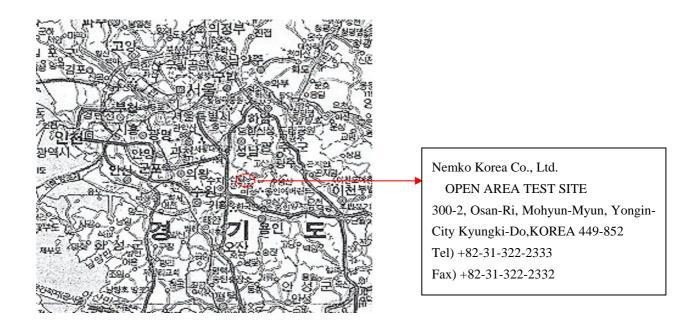


Fig. 1. The map above shows the Seoul in Korea vicinity area.

The map also shows Nemko Korea Corporation Ltd. EMC Lab and Incheon Airport.



## **DESCRIPTION OF TESTS**

#### **Radiation Hazard**

A 700-ml water load was placed in the center of the oven.

The power setting was set to maximum power.

While the oven was operating, the Microwave Survey Meter probe was moved slowly around the door seams to check for leakage.

### **Input Power Measurement**

The EUT was placed on a wooden table 0.8m at 1m distance Horn antenna.

A 700ml water load was placed in the center of the oven and the oven set to maximum power. A 700ml water load was chosen for its compatibility.

Input power and current were measured using a Power Analyzer.

Manufacturers to determine their input ratings commonly use this procedure.

### **Output Power Measurement**

The Caloric Method was used to determine maximum output power.

The initial temperature of a 1000ml water load was measured. The water load was placed in the center of the oven. The oven was operated at maximum output power for 120 seconds. Then the temperature of the water re-measured.

#### **Frequency measurements**

Following the above test, after operating the oven long enough to assure that stable operating temperature were obtained, the operating frequency was monitored as the input voltage was varied between 80 to 125 percent of the nominal rating. The water load was tested at 1000, 800, 600, 400, 200ml for the load varied.



### **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 0.4m height is placed 0.4m away from the vertical wall and 1.5m away from the side of wall of the shielded room

Kyoritsu (KNW-407) of the 50ohm/50uH Line Impedance Stabilization Network(LISN) is bonded to the shielded room.

The EUT is powered from the Kyoritsu LISN.

Power to the LISN is 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 LISN,

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

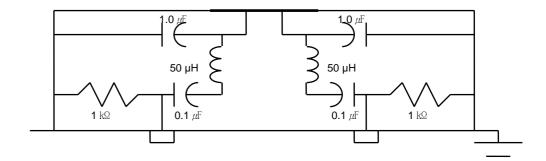


Fig. 2. LISN Schematic Diagram



#### 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 10m using Biconical log Antenna (Schwarzbeck, VULB 9166) for measurement from 30MHz to 1000MHz and made indoors at 3m using Doppels Teg Horn antenna (EMCO, DAA-37121) for measurement from 1GHz to 24GHz.

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 EUT is rotated about its vertical axis on the turntable, and the polarization and height of the receiving antenna are varied to obtain the highest field strength on the particular frequency under observation.

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

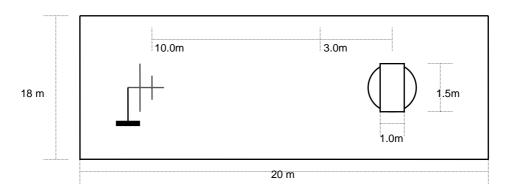


Fig. 3. Dimensions of Outdoor Test Site



### **Radiation Hazard**

Probe Location	Maximum Leakage [mW/Cm2]	Limit [mW/Cm2]
Α	0.05	1.00
В	0.11	1.00
С	0.06	1.00
D	0.05	1.00
All others	0.02	1.00

### **Input Power Measurement**

Operation mode	P rated (W)	P (W)	dP (%)	Required dP (%)
Power Input	1650	1680	1.8	+5%, -10%

## **RF Output Power Measurement**

Quantity of	Starting	Final	Elapsed Time	RF Power
Water	Temperature	Temperature	[seconds]	[watts]
[ml]	[Centigrade]	[Centigrade]	[Seconds]	[watts]
1000	10.0	40.8	120	1075

RF Power = (4.187 Joules/Cal) x (Volume in ml) x (Temp. Rise)
Time in seconds

Tested by : S. H. Baek

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### **Operating Frequency measurements**

#### ▶ Frequency vs Line Voltage Variation Test

		[Ro	om Temperature : 22.0℃]
Line Voltage Variation (Vac)	*)Pole	Frequency [MHz]	Allowed Tolerance for the ISM Band
	Н	Lower : 2409	
00 (000/)	Н	Upper : 2463	
96 (80%)	V	Lower : 2412	
	V	Upper : 2460	
	Н	Lower : 2411	
400 (000()	Н	Upper : 2458	
108 (90%)	V	Lower : 2419	
	V	Upper : 2459	Lower : 2400MHz
	Н	Lower : 2410	Upper : 2500MHz
400 (4400()	Н	Upper : 2459	
132 (110%)	V	Lower : 2413	
	V	Upper : 2459	
	Н	Lower : 2412	
450 (4050()	Н	Upper : 2459	
150 (125%)			

Lower : 2414 Upper : 2458

#### NOTE:

150 (125%)

\*Pol. H =Horizontal V=Vertical
 Initial load : 1000ml of water in the beaker.
 Line voltage varied from 96Vac to 150Vac.

٧

4. ISM Frequency : 2450MHz, Tolerance :  $\pm$ 50MHz

RESULT: Pass

Tested by : S. H. Baek

Buck sung blun



#### ▶ Frequency vs Load Variation Test

[ Room Temperature : 23.0 ℃]

		1	Temperature : 25.0 C
Volume of water	*)Pole	Frequency	Allowed Tolerance for
(cc)	)i Ole	[MHz]	the ISM Band
	Н	Lower : 2411	
1000	Н	Upper : 2460	
1000	V	Lower : 2407	
	V	Upper : 2460	
	Н	Lower : 2407	
800	Н	Upper : 2454	
000	V	Lower : 2441	
	V	Upper : 2456	
	Н	Lower : 2411	
600	Н	Upper : 2456	Lower : 2400MHz
800	V	Lower : 2415	Upper : 2500MHz
	V	Upper : 2460	
	Н	Lower : 2413	
400	Н	Upper : 2480	
400	V	Lower : 2407	
	V	Upper : 2471	
	н	Lower : 2405	
200	н	Upper : 2457	
200	V	Lower : 2404	
	V	Upper : 2481	

#### **NOTE:**

1. \*Pol. H =Horizontal V=Vertical
2. Initial load : 1000ml of water in the beaker.

2. Initial load : 1000iiii of water in the beaker.

3. Frequency was measured by using nominal voltage (AC120V).

4. ISM Frequency : 2450MHz, Tolerance :  $\pm$ 50MHz

RESULT: Pass

Tested by : S. H. Baek

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### **Conducted Emissions**

FCC ID: C5F7NF22MO120N

[ Room Temperature : 22.0℃]

Frequency	Level(dB <i>µ</i> V)		Line	Limit(	(dBμV)	Margi	n(dB)
(MHz)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.15	52.7	25.7	N	66.0	56.0	13.3	30.3
0.20	49.2	22.3	L	63.6	53.6	14.4	31.3
0.25	41.4	15.2	N	61.8	51.8	20.4	36.6
0.31	52.0	24.0	L	60.0	50.0	8.0	26.0
0.39	53.7	25.2	L	58.1	48.1	4.4	22.9
0.54	50.2	27.9	N	56.0	46.0	5.8	18.1
0.65	50.4	21.0	N	56.0	46.0	5.6	25.0
1.34	25.9	5.7	L	56.0	46.0	30.1	40.3
2.65	40.4	14.2	N	56.0	46.0	15.6	31.8
13.56	24.7	9.2	N	60.0	50.0	35.3	40.8

<sup>\*)</sup> Correction factor was included to Test Level (dBuV)

#### NOTES:

- 1. Measurements using CISPR quasi-peak mode & average mode.
- 2. See attached Plots.
- 3. LINE : L =Line , N = Neutral

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### **Radiated Emissions**

FCC ID: C5F7NF22MO120N

301	/Hz ~	1GHz

► 30MHz ~ 1	GHz			[ Ro	om Temperat	ure : 23.5℃]
Frequency	Reading	Pol*	AF+CL+Amp	Result(PK)	Limit(10m)	Margin
(MHz)	(dB <i>µ</i> V)	(H/V)	(dB)**	(dB <i>μ</i> V/m)	(dB <i>µ</i> V/m)	(dB)
295.78	34.9	Н	-11.4	23.5	61.28	37.8
303.54	40.7	Н	-11.2	29.5	61.28	31.8
613.94	27.7	Н	-3.2	24.5	61.28	36.8
676.02	27.4	Н	-1.6	25.8	61.28	35.5
908.82	40.3	H	4.1	44.4	61.28	16.9
924.34	26.2	٧	4.3	30.5	61.28	30.8
967.02	42.8	H	5.1	47.9	61.28	13.4
974.78	34.4	٧	5.3	39.6	61.28	21.7
984.48	28.2	٧	5.4	33.6	61.28	27.7
990.30	26.1	٧	5.5	31.6	61.28	29.7
998.06	24.3	V	5.7	30.0	61.28	31.3

<Radiated Measurements at 10meters>

#### **NOTES:**

- 1. \*Pol. H =Horizontal V=Vertical
- 2. \*\*AF+CL+Amp. = Antenna Factor + Cable Loss + Amplifier.
- 3. Distance Correction factor : 20 \* log (300/10) = 30dBuV/m
- 4. The limit at 300meters is 20 \* LOG (25 \* SQRT (RF Power/500))
- 5. All other emissions were measured while a 700ml load was placed in the center of the oven.
- 6. If no frequencies are specified in the tables, no measurement for peak & average was necessary.

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#### **Radiated Emissions**

FCC ID: C5F7NF22MO120N

▶ 1GHz ~ 2	24GHz				[ Roon	n Temperatu	ıre : 21.5℃]
Frequency	Reading	Pol*	AF+CL+Amp	K	Limit (with K)	Results	Margin
(MHz)	(dB <i>μ</i> V)	(H/V)	(dB)**	(dB)***	(dB <i>μ</i> V/m)	(dB <i>⊭</i> V/m)	(dB)
4067.00	21.7	Н	10.30	40.53	71.81	32.00	39.81
4903.00	42.3	٧	10.00	40.00	71.28	52.30	18.98
6980.00	24.9	٧	13.80	40.00	71.28	38.70	32.58
7349.00	40.2	H	15.20	40.00	71.28	55.40	15.88
8413.00	27.3	٧	15.70	40.00	71.28	43.00	28.28
9810.00	36.2	<b>V</b>	18.00	40.00	71.28	54.20	17.08
1467.00	33.5	٧	24.50	40.00	71.28	58.00	13.28
1711.00	32.1	٧	27.15	40.00	71.28	59.25	12.03
1715.00	34.0	Н	27.20	40.00	71.28	61.20	10.08

#### <Radiated Measurements at 3meters>

#### **NOTES:**

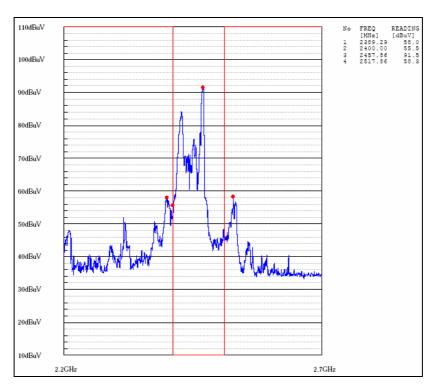
- 1. \*Pol. H =Horizontal V=Vertical
- 2. \*\*AF+CL+Amp. = Antenna Factor + Cable Loss + Amplifier.
- 3. \*\*\*Computations to determine compliance
- 4. Distance Correction factor: 20 \* log (300/3)=40dBuV/m
- 5. The limit at 300meters is 20 \* LOG (25 \* SQRT (RF Power/500))
- 6. Load for measurement of radiation on second and third harmonic: Two loads, one of 700ml and the other of 300ml, of water were used. Each load was tested both with the beaker located in the center of the oven and with it in the corner.
- 7. The test was performed at peak detector mode with RBW 1MHz, VBW 10Hz.
- 8. All other emissions were measured while a 700ml load was placed in the center of the oven.
- 9. If no frequencies are specified in the tables, no measurement for peak with RBW 1MHz & VBW 10Hz.

Tested by: S. H. Baek

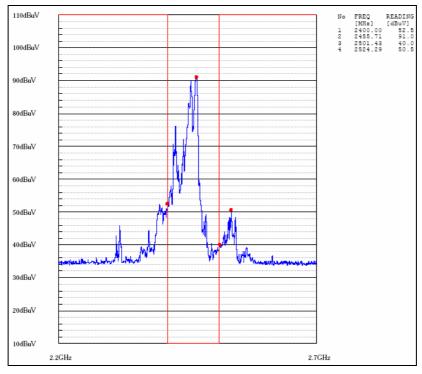
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### • Frequency vs Line Voltage Variation Test



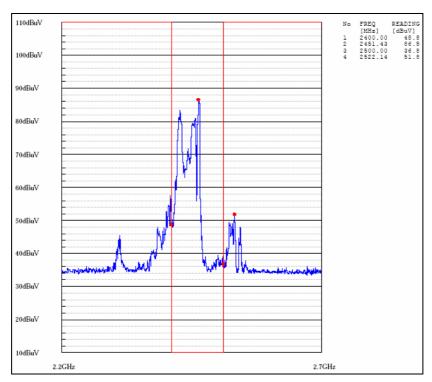
Horizontal (96V, 1000cc)



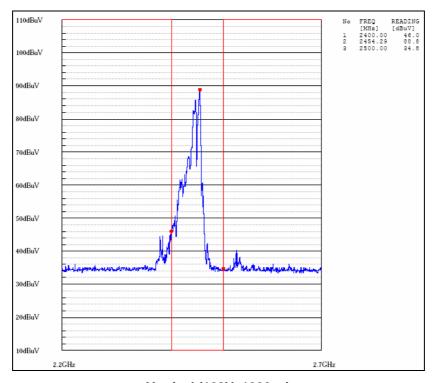
Vertical (96V, 1000cc)



### Frequency vs Line Voltage Variation Test



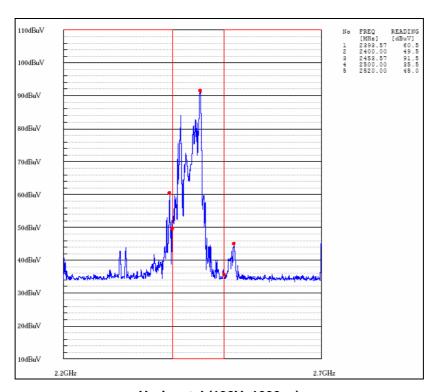
Horizontal (108V, 1000cc)



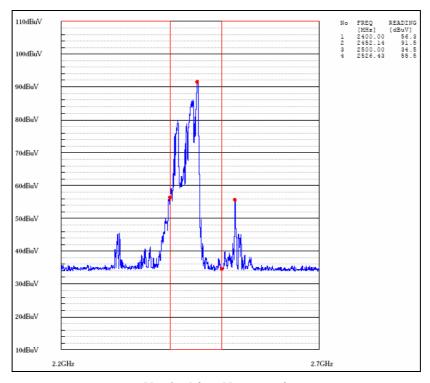
Vertical (108V, 1000cc)



### Frequency vs Line Voltage Variation Test



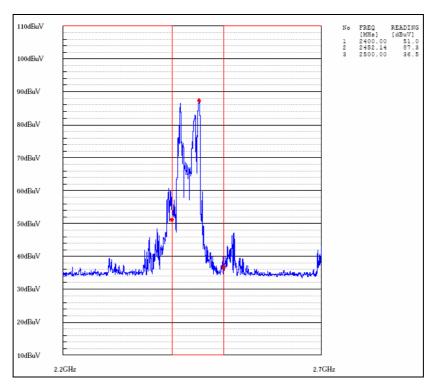
Horizontal (132V, 1000cc)



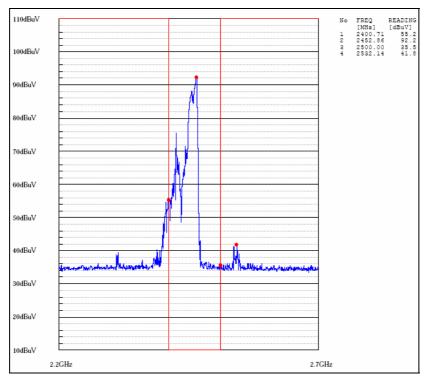
Vertical (132V, 1000cc)



### Frequency vs Line Voltage Variation Test



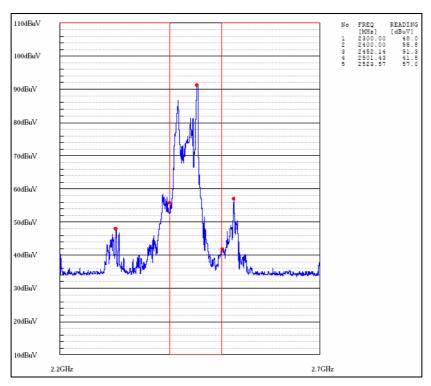
Horizontal (150V, 1000cc)



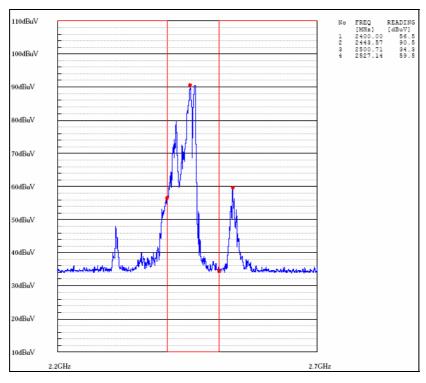
Vertical (150V, 1000cc)



#### Frequency vs Load Variation Test



Horizontal (120V, 1000cc)

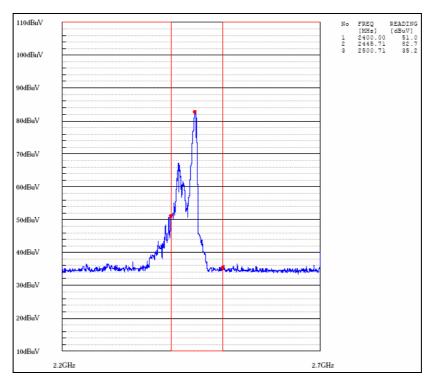


Vertical (120V, 1000cc)

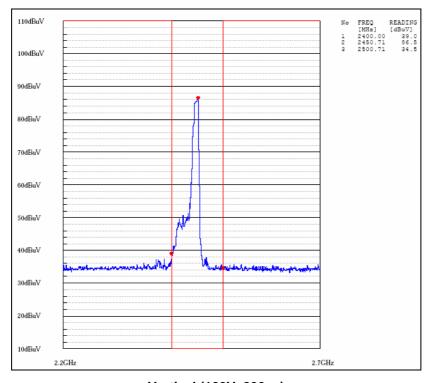
Daewoo Electronics Corporation. FCC ID:C5F7NF22MO120N



#### Frequency vs Load Variation Test



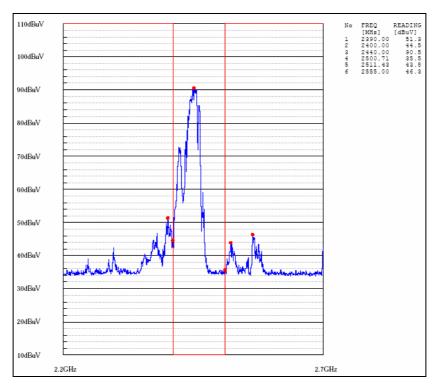
Horizontal (120V, 800cc)



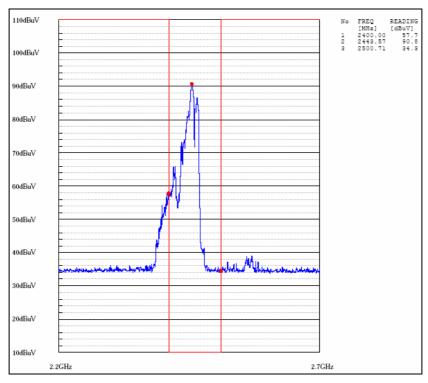
Vertical (120V, 800cc)



#### Frequency vs Load Variation Test



Horizontal (120V, 600cc)

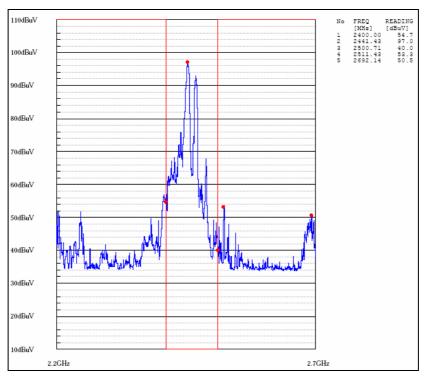


**Vertical (120V, 600cc)** 

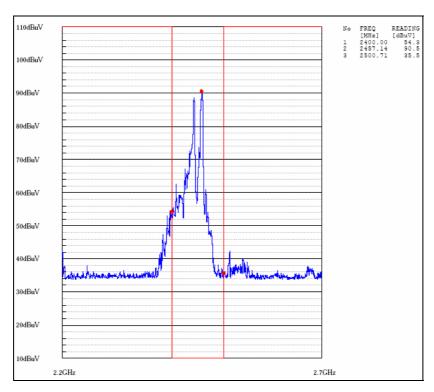
Daewoo Electronics Corporation. FCC ID:C5F7NF22MO120N



#### • Frequency vs Load Variation Test



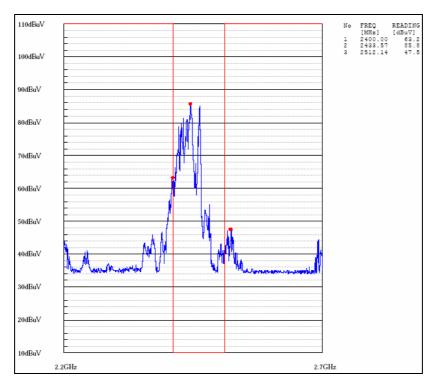
Horizontal (120V, 400cc)



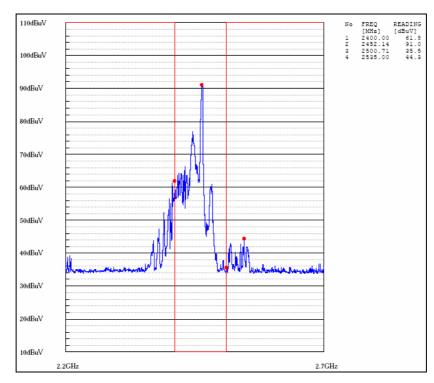
Vertical (120V, 400cc)



#### Frequency vs Load Variation Test



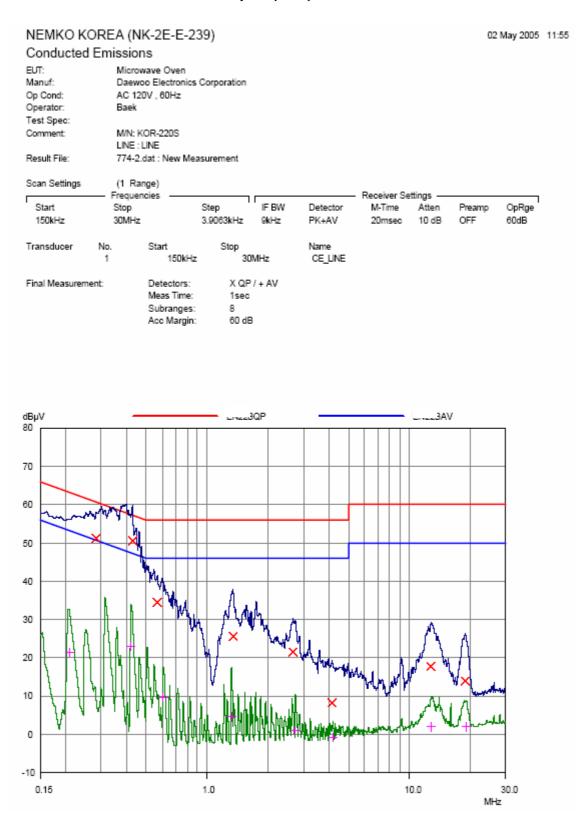
Horizontal (120V, 200cc)



Vertical (120V, 200cc)



#### • Conducted Emission at the Mains port (Line)





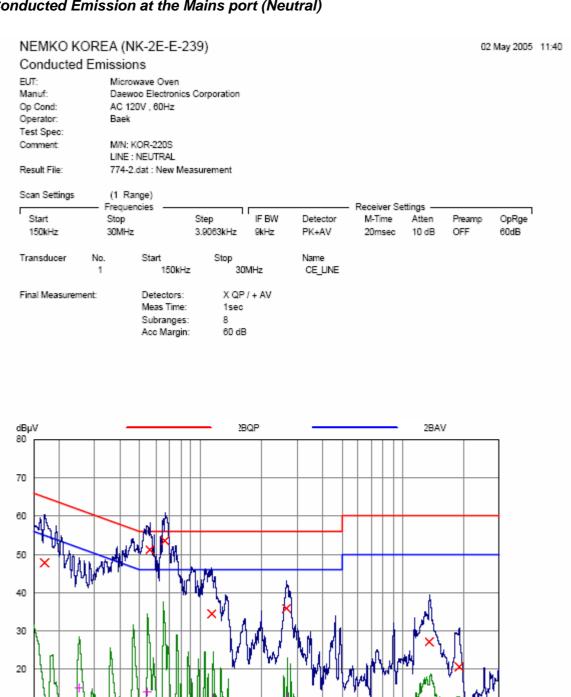
10

0

-10 0.15

### **PLOTS OF EMISSIONS**

#### Conducted Emission at the Mains port (Neutral)



10.0

1.0

30.0 MHz



## **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)	± 0.5
Cable Loss	Normal (k=2)	± 0.04
Receiver Specification	Rectangular	± 2.0
Antenna directivity		
Antenna Factor variation with Height	7	
Antenna Phase Center Variation	Rectangular	± 1.0
Antenna Factor Frequency Interpolation	7	
Measurement Distance Variation		
Site Inperfections	Rectangular	± 2.0
Mismatch:Receiver VRC ri=0.3		
Antenna VRC rR=0.1(Bi)0.4(Lp)	U-Shaped	+ 0.25 / - 0.26
Uncertainty Limits 20Log(1+/-ri rR)		
System Repeatibilty	Std.deviation	± 0.05
Repeatability of EUT		-
Combined Standard Uncertainty	Normal	± 1.77
Expended Uncertainty U	Normal (k=2)	± 3.5

### 2. Conducted Uncertainty Calculation

Contribution	Probability Distribution	Uncertainty(+/-dB)
Receiver Specification	Normal (k=2)	± 2.0
LISN coupling spec.	Normal (k=2)	± 0.4
Cable and input attenuator cal.	Rectangular	± 0.4
Mismatch:Receiver VRC ri=0.3		
LISN vrc rg=0.1	U-Shaped	$\pm 0.26$
Uncertainty Limits 20Log(1+/-ri rR)		
System Repeatibilty	Std.deviation	± 0.68
Repeatability of EUT	-	-
Combined Standard Uncertainty	Normal	± 1.18
Expended Uncertainty U	Normal (k=2)	± 2.4



# LIST OF TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	<b>Calibration Date</b>
1	*Test Receiver	R & S	ESCS 30	2004.08
2	*Test Receiver	R & S	ESCS 30	2004.12
3	Amplifier	НР	8447F	2004.07
4	*Amplifier	НР	8447F	2005.01
5	Amplifier	НР	8447F	2004.10
6	*Amplifier	НР	8449B	2005.03
7	*Spectrum Analyzer	НР	8566B	2005.03
8	Spectrum Analyzer	НР	8568B	2004.10
9	*Spectrum Analyzer	Anritsu	MS2668C	2004.12
10	*Logbicon Super Antenna	Schwarzbeck	VULB9166	2004.05
11	*Doppels Teg Horn	EMCO	DAA-37121	2004.10
12	*Biconical Log Antenna	ARA	LPB-2520/A	2005.01
13	High Voltage Probe	R & S	ESH2-Z3	2004.06
14	*Microwave Survey Meter	<b>Holaday Industries</b>	H1-1801	2004.07
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	*Position Controller	EM Eng.	N/A	N/A
20	*Turn Table	EM Eng.	N/A	N/A
21	*Antenna Mast	EM Eng.	N/A	N/A
22	*Anechoic Chamber	EM Eng.	N/A	N/A
23	*Shielded Room	EM Eng.	N/A	N/A
24	*Position Controller	Seo-Young EMC	N/A	N/A
25	*Turn Table	Seo-Young EMC	N/A	N/A
26	*Antenna Mast	Seo-Young EMC	N/A	N/A
27	*Anechoic Chamber	Seo-Young EMC	N/A	N/A
28	*Shielded Room	Seo-Young EMC	N/A	N/A

<sup>\*)</sup> Test equipment used during the test



# APPENDIX D - SCHEMATIC DIAGRAM



## APPENDIX E - USER'S MANUAL



## APPENDIX F - BLOCK DIAGRAM