



FCC MEASUREMENT / TECHNICAL TEST REPORT



SAMSUNG ELECTRONICS CO., LTD.
MICROWAVE OVEN MODEL MW6886W
WITH SAMSUNG MAGNETRON OM-75P

FILE: NC2425
PROJECT: 98SC05768
ISSUED: May 28, 1998

NAME OF MANUFACTURER: Samsung Electronics America, Inc.
ADDRESS OF MANUFACTURER: 85 West Tasman Drive
San Jose, CA 95134 USA
EQUIPMENT UNDER TEST: Microwave Oven Model MW6886W
with Samsung Magnetron Model OM-75P
REPORT PREPARED BY: Underwriters Laboratories, Inc.
1655 Scott Boulevard
Santa Clara, CA 95050-4169 USA
(408) 985-2400

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This report contains 8 pages + 11 data pages. Page 1 of 8

Underwriters Laboratories Inc., 1655 Scott Blvd., Santa Clara, CA 95050 USA
Tel.: 408-985-2400 Fax: 408-296-3256

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this investigation was to perform measurements of electromagnetic interference (EMI) generated by the equipment under test (EUT) for comparison to limits specified in the referenced standards.

1.2 DESCRIPTION OF EQUIPMENT UNDER TEST

The equipment under test (EUT) is a microwave oven. The EUT is provided with an electronic control. The electronic control provides the user with a selection of time duration and power level. The maximum time duration setting is 99 minutes. Maximum power level setting is 100%. The input electrical rating is 120 Vac, 60 Hz, 1.5 kW.

1.3 REFERENCED STANDARDS AND TEST FACILITIES

The procedures and methods used throughout these tests may be found in the following:

1. Code of Federal Regulations (CFR) Title 47, Part 18, Industrial, Scientific, and Medical Equipment, Subpart - C; and,
2. FCC/OET MP-5 (1986), FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical Equipment.

Details of the measurement facilities used for these tests have been filed with the Federal Communications Commission's Laboratory in Columbia, Maryland and accepted in a letter dated September 24, 1997 (Ref. No. 31040/SIT 1300F2). The facility is located at:

Underwriters Laboratories Inc., 1655 Scott Boulevard, Santa Clara, CA

1.4 OPERATING CONDITIONS/TEST CONFIGURATION

The EUT was provided for tests as a stand-alone device; it was prepared for testing in accordance with the manufacturer's instructions. The EUT was operated at maximum (continuous) RF output power. The loads consisted of water in a glass beaker in the amounts specified in the test procedure.

2.0 RADIO NOISE EMISSION MEASUREMENTS PROCEDURES/RESULTS

2.1 RADIATION HAZARD MEASUREMENT

Radiation leakage was measured in the as-received condition with the oven door closed using a microwave leakage meter.

A 700 ml water load was placed in the center of the oven and the oven was operated at maximum output power.

- ☒ **There was no microwave leakage exceeding a power level of 0.5 mW/cm² observed at any point 5 cm or more from the external surface of the oven.**

A maximum of 1.0 mW/cm² is allowed in accordance with the applicable Federal Standards. Hence, microwave leakage in the as-received condition with the oven door closed was below the maximum allowed.

2.2 INPUT POWER

Input power and current was measured using a power analyzer. A 275 ml water load was placed in the center of the oven and the oven was operated a maximum output power. A 275 ml water load was chosen for its compatibility with the procedure commonly used by manufacturers to determine their input ratings.

Input Voltage (Vac)	Input Current (amps)	Measured Input power (watts)
120	14.1	1590

- ☒ Based on the measured input power, the EUT was found to be operating within the intended specifications.

2.3 RF OUTPUT POWER MEASUREMENT

The Caloric Method was used to determine maximum RF output power. The rated output power is 900 watts. The initial temperature of a 1000 ml 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, the temperature of the water was re-measured.

Quantity of Water (ml)	Starting Temperature (° C)	Final Temperature (° C)	Elapsed Time (seconds)
1000	21	46	120

$$\text{Power} = \frac{(4.2 \text{ joules/Cal}) \times (\text{Volume in ml}) \times (\text{Temp. Rise})}{\text{Time in Sec.}}$$

$$\text{Power} = \frac{(4.2) \times (1000) \times (10)}{120}$$

$$\text{Power} = \boxed{875 \text{ watts}}$$

- ☐ The measured output power was found to be less than 500 watts. Therefore, in accord with Section 18.305 of Subpart - C, the measured out-of-band emissions were compared to the limit of 25 $\mu\text{V}/\text{meter}$ at a 300 meter measurement distance.
- ☒ The measured output power was found to exceed 500 watts. Therefore, in accordance with Section 18.305 of Subpart - C, the measured out-of-band emissions were compared with the limit calculated as follows:

$$LFS = 25 * \text{SQRT}(\text{Power Output}/500)$$

where: LFS is the maximum allowable field strength for out-of-band emissions in $\mu\text{V}/\text{meter}$ at a 300 meter measurement distance.
Power Output is the measured output power in watts.

The measured out-of-band emissions were compared to a 300 meter limit of **33 $\mu\text{V}/\text{meter}$** . [33 $\mu\text{V}/\text{m}$ = 30.3 dB($\mu\text{V}/\text{m}$)]
[30.3 dB($\mu\text{V}/\text{m}$) @ 300m = 70.3 dB($\mu\text{V}/\text{m}$) @ 3m]
[30.3 dB($\mu\text{V}/\text{m}$) @ 300m = 79.8 dB($\mu\text{V}/\text{m}$) @ 1m]

2.4 OPERATING FREQUENCY MEASUREMENTS

2.4.1 VARIATION IN OPERATING FREQUENCY WITH TIME

The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000 ml water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored until the water load was reduced to 20 percent of the original load.

The results of this test are as follows:

Initial load: 1000 ml. Load at completion of test: 200 ml.

Maximum frequency observed: 2445 MHz
Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2432 MHz
Minimum frequency allowed: 2400 MHz

Refer to data pages 1 & 2 for details of the variation in operating frequency with time measurements.

2.4.2 VARIATION IN OPERATING FREQUENCY WITH LINE VOLTAGE

The EUT was operated/warmed by at least 10 minutes of use with a 1000 ml water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The results of this test are as follows:

Line voltage varied from 96 Vac to 150 Vac.

Maximum frequency observed: 2454 MHz
Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2429 MHz
Minimum frequency allowed: 2400 MHz

Refer to data pages 3 & 4 for details of the variation in operating frequency with line voltage measurements.

2.5 RADIATED EMISSIONS

Radiated emissions were measured over a frequency range of 100 MHz through the highest detectable harmonic emission (fifth harmonic), of the operating frequency, inclusive. For this test, the device under test was supported by a 1 meter high wooden table in a semi-anechoic EMC test chamber. The table was placed on a turn table.

The measurement antenna was placed at 3 meters for measurements from 30-1000 MHz, and at 1 meter for measurements beyond 1 GHz, respectively, from the device under test. The indicated frequency range was swept as the device under test was rotated about its vertical axis in a full 360 degree rotation.

During the preliminary tests, the load consisted of 700 ml tap water placed in the center of the oven. Plots of the preliminary tests (peak data) are contained on data pages 8 through 11. Emissions were observed while the device under test was operated at maximum output power.

The level of the emissions near the edge of the designated ISM Frequency band were measured. For this test, the load consisted of 700 ml water load located in the center of the oven. The data obtained during this test is contained on data page 5.

The levels of the second and third harmonic, inclusive were measured with a 300 ml and 700 ml water load alternately placed in the center and right front corner of the oven. The data obtained during these tests is contained on data page 6.

The maximum of all other out-of-band emissions were measured while a 700ml load was placed in the center of the oven. The data obtained during this test is contained on data page 7.

Maximum readings were recorded after variations in antenna polarization, height, device orientation, load position and size.

- ☒ **For all emissions the equivalent 300 meter intensity was calculated assuming a linear decrease in the intensity of the RFI field with increased distance. In the operating mode and conditions described, there were no over-limit emissions discovered.**

FILE: NC2425
PROJECT: 98SC05768
MODEL: MW6886W
ISSUED: May 28, 1998

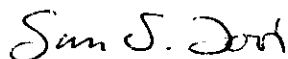
FCC ID: A3LMW6886W

3.0 MEASUREMENT EQUIPMENT:

The test equipment used for these measurements includes:

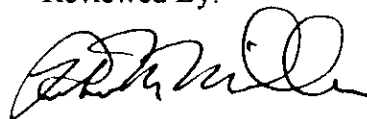
- Hewlett Packard, EMI Receiving System: Model 8566B Spectrum Analyzer S/N 3638A08593, Model OPT Spectrum Analyzer Display S/N 3552A22050, Model 85650A Quasi-Peak Adapter S/N 3303A01831, Model 85685A RF Preselector, S/N 3506A01538, Cal Date 11-24-97, and Model 8449B Preamplifier, S/N 3008A00884, Cal Date 11-24-97.
- Integrated Microwave Co., High Pass Filter, P/N 924084, Cal Date 9-10-97.
- Simpson, Microwave Leakage Meter, Model 380m, S/N 10845, Cal. Date 09-16-97.
- Doric Scientific, Digital Temperature Indicator, Model 400A, S/N 106091, Cal. Date 03-17-98.
- Electro-Metrics Inc. Model EM-6912A Biconnical Antenna, S/N 126, Cal. Date 10-04-97.
- Electro-Metrics Inc. Model EM-6950 Log Periodic Antenna, S/N 935, Cal. Date 10-04-97.
- Electro-Metrics Inc. Model EM-6961 Horn Rigid Guide Antenna, S/N 6275, Cal. Date 09-23-97.
- Fluke, Digital Multimeter, Model 87, S/N 67361177, Cal. Date 04-10-97.
- Voltech, Universal Power Analyzer, Model PM3000A, S/N 1527, Cal. Date 01-21-98.

Tested By:



San S. Toor
Senior Project Engineer
International EMC Services

Reviewed By:



Robert Miller
Associate Managing Engineer
International EMC Services

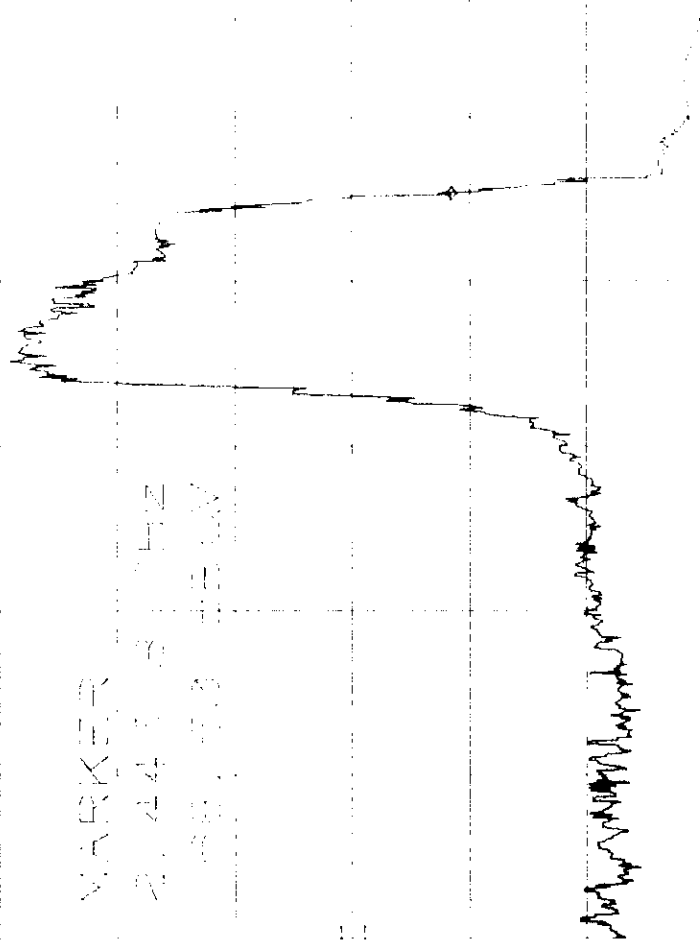
VXR 2.4475 GHz
94.75 dBW

VARIATION IN FREQUENCY w/ TIME
SAMSUNG, MODEL MW6886W

REF 100.0 dBW ATEN 10.0 dB

12 dB

VARKER
2.4475 GHz
94.75 dBW



START 2.420 GHz
REF 100.0 dBW ATEN 10.0 dB

STOP 2.480 GHz
94.75 dBW

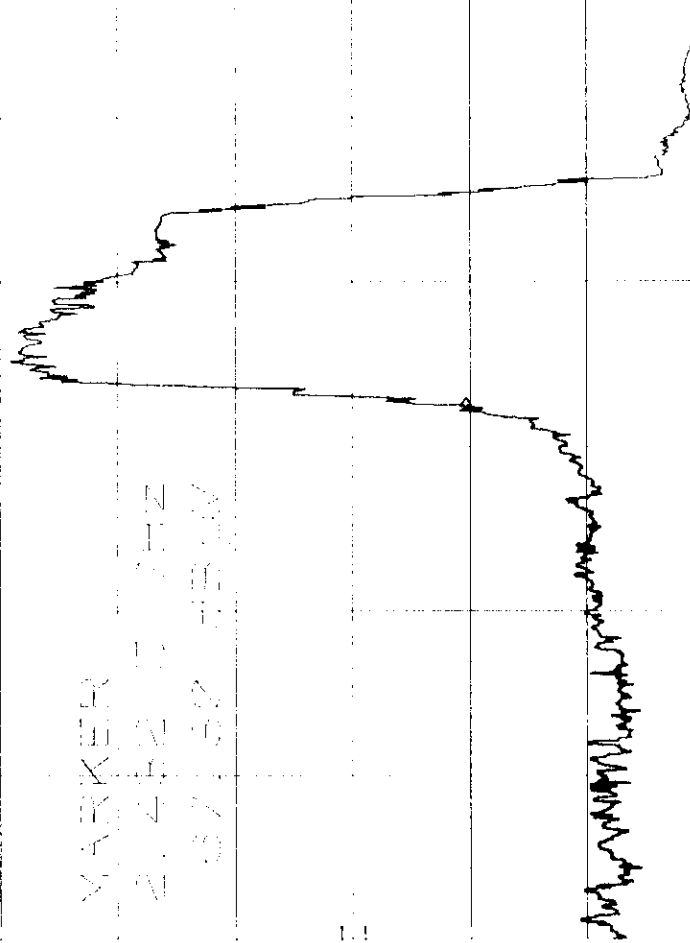
VARI 21.472 MHz

REF 100.0 dBW ATTEN 0.0 dB 20 dB

VARIATION IN FREQUENCY w/ TIME
SAMSUNG, MODEL MW6886W

10 DBW

MARKER
21.472 MHz
07.02 dBW



CURR

START 21.420 MHz
RES BW 1 MHz

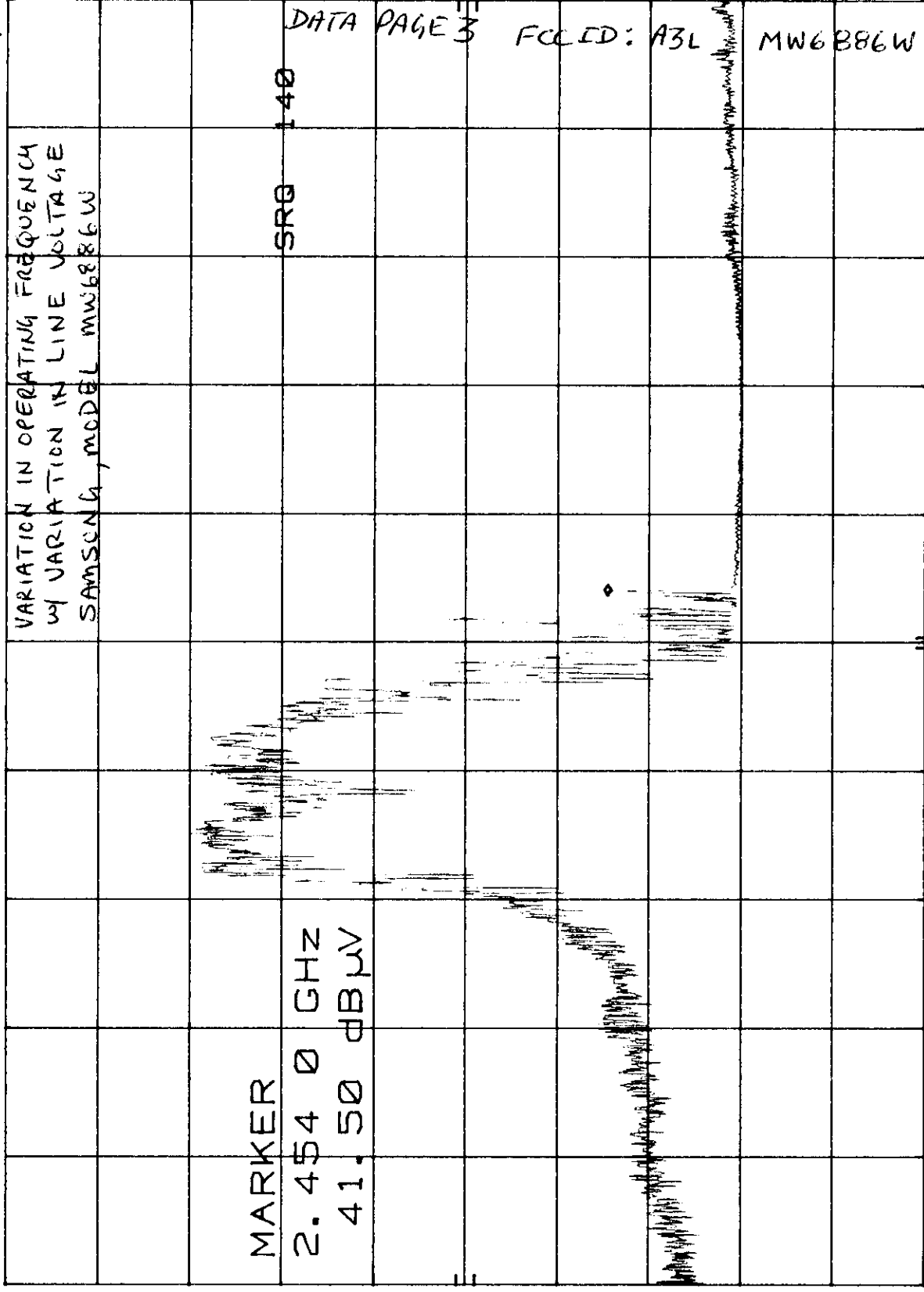
STOP 21.520 MHz
SWE 10.0 MHz

START 21.420 MHz
RES BW 1 MHz

MKR 2.454 0 GHz
41.50 dBμV

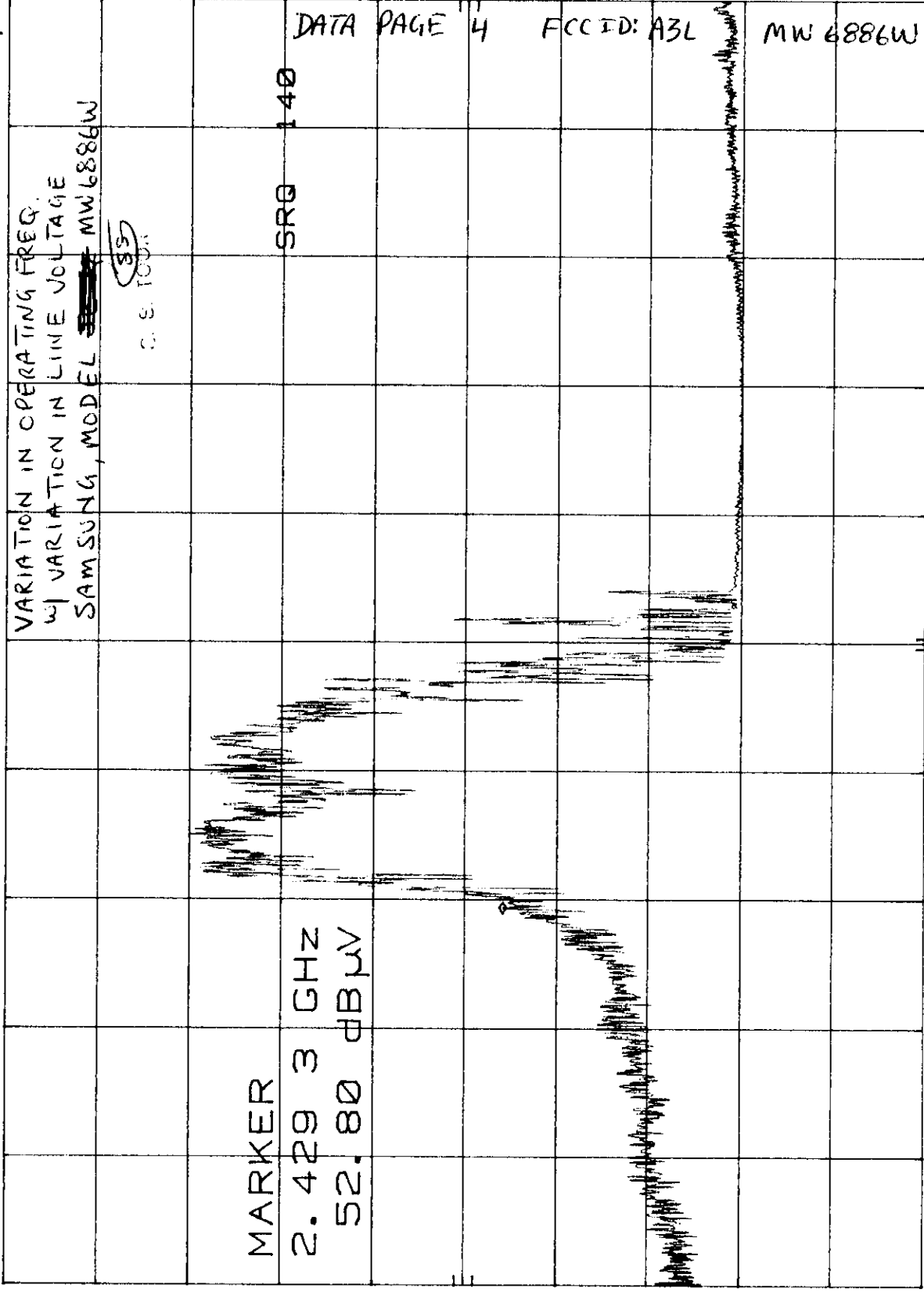
hp REF 107.0 dBμV ATTN 10 dB

10 dB/



START 2.400 GHz
RES BW 1 MHz (1)
STOP 2.500 GHz
SWP 4.80 sec
VBW 100 Hz

HP MKR 2.429 3 GHz 52.80 dBμV
10 dB/ REF 107.0 dBμV ATTN 10 dB



START 2.400 GHz STOP 2.500 GHz
RES BW 1 MHz (1) VBW 100 Hz
SWP 4.80 sec

FILE: NC2425
PROJECT: 98SC05768
MODEL: MW6886W
ISSUED: May 28, 1998

FCC ID: A3LMW6886W

UNDERWRITERS LABORATORIES INC.
ISM SIDEBAND MEASUREMENTS
Data Page 5

Date Tested: May 15, 1998

Test Requirements: CFR Title 47, Part 18, Subpart - C
Test Procedure: FCC/OST MP-5 (1986)
Receiver: Hewlett-Packard, Spectrum Analyzer, Model HP8566B,
S/N 3638A08593
Resolution Bandwidth: 1 MHz
Video Bandwidth: 3 Hz (to simulate linear average detection)
Antenna: Electro-Metrics Inc., Horn Rigid Guide, Model EM-6961,
S/N 6275
Measurement Distance: 1 meter
Load: 700 ml water in center of oven

Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
2 399 V	23.8	3.9	28.7	56.4	2.2	33
2 399 H	22.9	3.9	28.7	55.5	2.0	33
2 501 V	16.6	3.9	28.9	49.4	1.0	33
2 501 H	15.5	3.9	28.9	48.3	0.9	33

V - indicates vertical antenna polarity.
H - indicates horizontal antenna polarity.

CALCULATIONS - Calculation of the equivalent 300 meter field strength was performed assuming a linear fall-off in the field strength with increased distance from the radiating source.

Field Strength (μV/meter at 300 meters) = $K \times 10^{[SI+AF+CL/20]}$

Where: SI is the intensity of the signal in dB(μV)
AF is the antenna factor in dB; CL is the cable loss in dB.
K is the ratio of: [measurement distance/requirement distance]

FILE: NC2425
PROJECT: 98SC05768
MODEL: MW6886W
ISSUED: May 28, 1998

FCC ID: A3LMW6886W

UNDERWRITERS LABORATORIES INC.
HARMONIC MEASUREMENTS
Data Page 6

Date Tested: May 15, 1998

Test Requirements: CFR Title 47, Part 18, Subpart - C
Test Procedure: FCC/OST MP-5 (1986)
Receiver: Hewlett-Packard, Spectrum Analyzer, Model HP8566B,
S/N 3638A08593
Resolution Bandwidth: 1 MHz
Video Bandwidth: 3 Hz (to simulate linear average detection)
Antenna: Electro-Metrics Inc., Horn Rigid Guide, Model EM-6961,
S/N 6275
Measurement Distance: 1 meter

Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable* Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
Load: 700 ml water in center of oven						
4 603 H	16.3	5.9	33.4	55.6	2.0	33
7 322 H	34.0	-24.8	36.5	45.7	0.6	33
Load: 700 ml water in right front corner of oven						
4 612 H	16.8	5.9	33.4	56.1	2.1	33
7 341 H	34.9	-24.7	36.6	46.8	0.7	33
Load: 300 ml water in center of oven						
4 613 H	16.3	5.9	33.4	55.6	2.0	33
7 321 H	41.6	-24.8	36.5	53.3	1.5	33
Load: 300 ml water in right front corner of oven						
4 613 H	16.1	5.9	33.4	55.4	1.0	33
7 329 H	30.6	-24.8	36.5	42.3	0.4	33

V - indicates vertical antenna polarity; H - indicates horizontal antenna polarity.
(*) - indicates that when high pass filter and an preamplifier was used, the cable loss will include preamplifier gain.

CALCULATIONS - Calculation of the equivalent 300 meter field strength was performed assuming a linear fall-off in the field strength with increased distance from the radiating source.

$$\text{Field Strength } (\mu\text{V/meter at 300 meters}) = K \times 10^{[SI+AF+CL/20]}$$

Where: SI is the intensity of the signal in dB(μV)
AF is the antenna factor in dB; CL is the cable loss in dB
K is the ratio of:[measurement distance/requirement distance]

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 MODEL: MW6886W
 ISSUED: May 28, 1998

FCC ID: A3LMW6886W

UNDERWRITERS LABORATORIES INC.
 OUT-OF-BAND EMISSIONS MEASUREMENTS
 Data Page 7

Date Tested: May 15, 1998

Test Requirements: CFR Title 47, Part 18, Subpart - C
 Test Procedure: FCC/OST MP-5 (1986)
 Receiver: Hewlett-Packard, Spectrum Analyzer, Model HP8566B, S/N 3638A08593
 Resolution Bandwidth: 100 kHz (< 1 GHz) and 1 MHz (> 1 GHz)
 Video Bandwidth: 10 Hz (to simulate linear average detection)
 Antenna: Electro-Metrics Inc., Horn Rigid Guide Model EM-6961, S/N 6275; and Log-Periodic Model EM6950, S/N 935
 Measurement Distance: 3 meter (< 1GHz) and 1 meter (> 1 GHz)
 Load: 700 ml water in center of oven

Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable Loss (dB)	Antenna Factor (dB)	3 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
920 H	-6.8	3.6	22.9	19.7	0.1	33

Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable* Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
1 840 H	15.2	3.7	26.5	45.4	0.6	33
2 199 V	21.3	3.8	28.3	53.4	1.6	33
2 394 V	22.5	3.9	28.7	55.1	1.9	33
2 534 H	17.1	4.0	29.0	50.1	1.1	33
2 716 H	15.3	4.1	29.6	49	0.9	33
6 458 H	26.3	-25.4	35.7	36.6	0.2	33
7 120 H	27.2	-24.9	36.4	38.7	0.3	33
9 786 H	29.7	-23.2	38.4	44.9	0.6	33
14 596 H	30.1	-19.8	40.8	51.1	0.6	33
17 190 H	29.5	-17.6	45.9	57.8	2.6	33

V - indicates vertical antenna polarity; H - indicates horizontal antenna polarity.

(*) - indicates that when high pass filter and an preamplifier was used, the cable loss will include preamplifier gain.

CALCULATIONS - Calculation of the equivalent 300 meter field strength was performed assuming a linear fall-off in the field strength with increased distance from the radiating source.

$$\text{Field Strength } (\mu\text{V/meter at 300 meters}) = K \times 10^{[SI+AF+CL/20]}$$

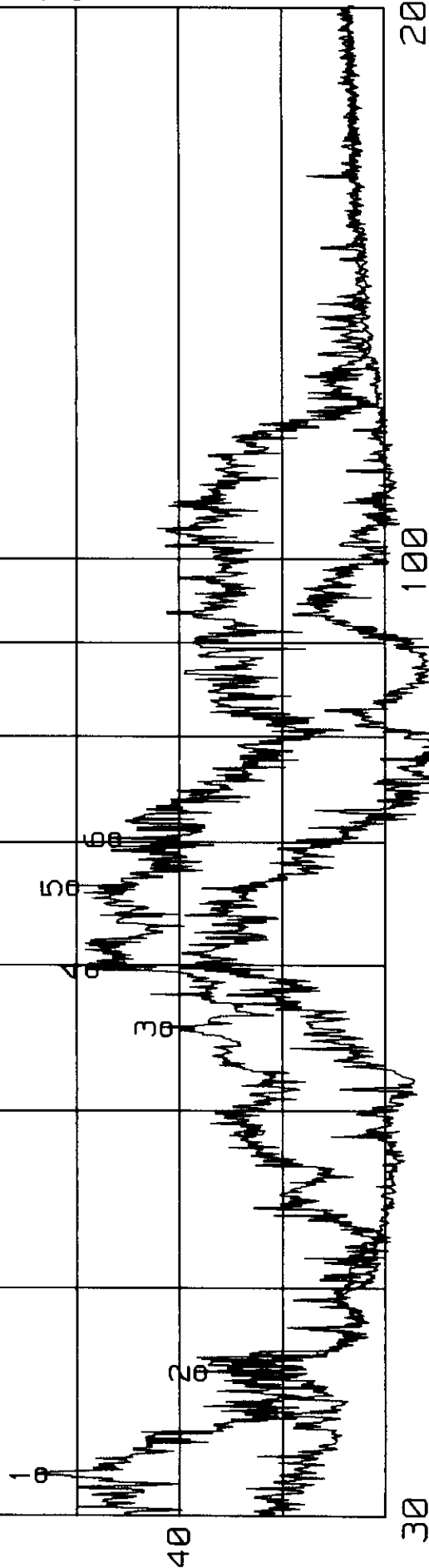
Where: SI is the intensity of the signal in dB(μV)
 AF is the antenna factor in dB; CL is the cable loss in dB.
 K is the ratio of: [measurement distance/requirement distance]

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FCC Part 18 @ 3m
SAMSUNG ELECTRONICS CO. LTD.
MODEL: MW6886W microwave oven
GREEN=vertical, RED=horizontal
RBW=VBW= 1 MHz

MICROWAVE OVEN AT 3m > 500W

[dB(uV/meter)]



Frequency [MHz]

FCC Part 18 @ 3m
SAMSUNG ELECTRONICS CO. LTD.
MODEL: MW6886W microwave oven
GREEN=vertical, RED=horizontal
RBW= VBW = 1 MHz

MICROWAVE OVEN AT 3m > 500W

[dB(uV/meter)]

1 2 3

40

50

60

100

80

60

40

20

FCC 18 @ 1m
1-15 GHz, MICROWAVE OVEN
HORIZONTAL
RWB=1MHz, VBW=100Hz
SAMSUNG MODEL MW6886W

MICROWAVE OVEN AT 1M > 500W

140

120

[dB(uV/meter)]

100

80

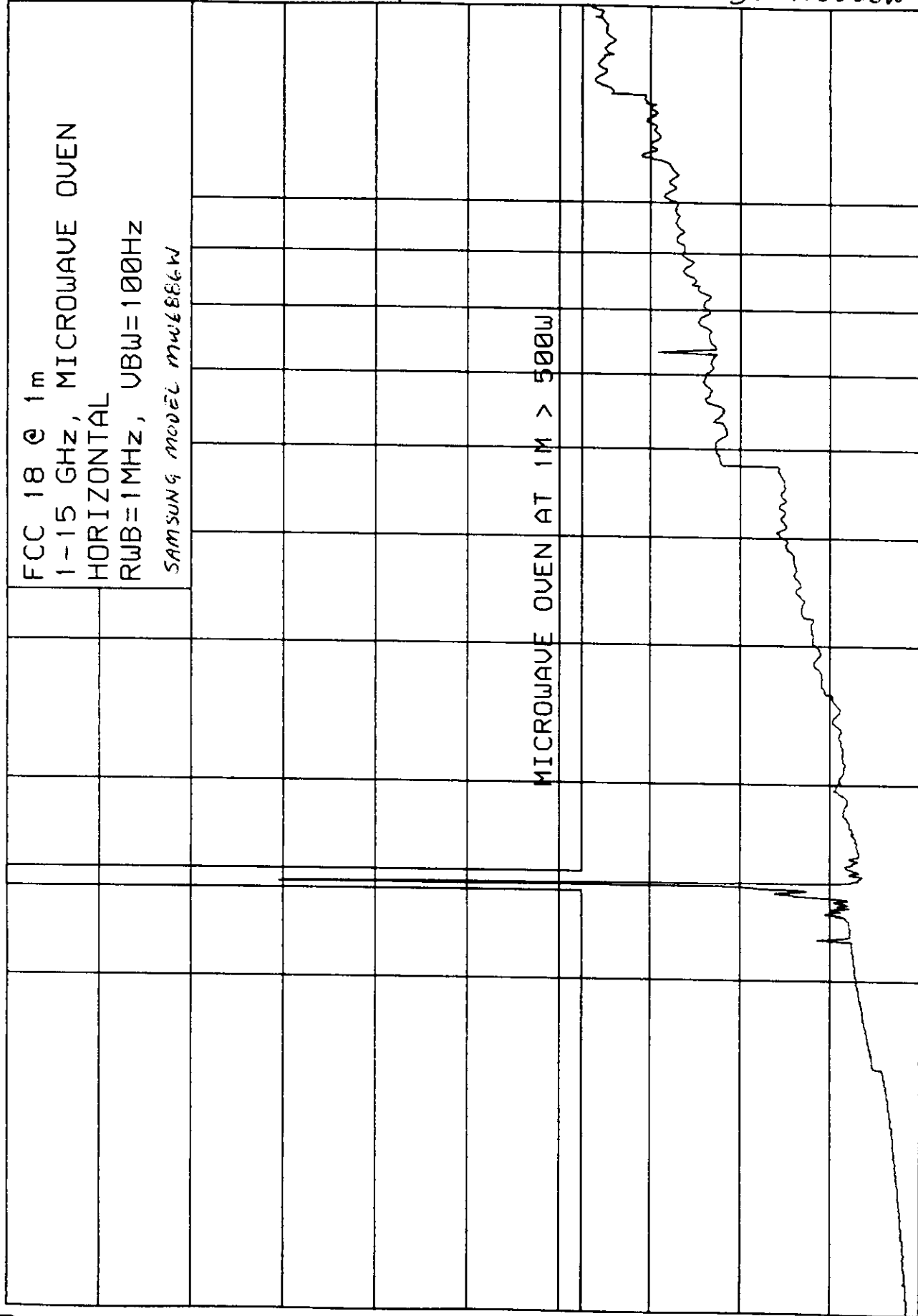
60

1000

10000

15000

Frequency [MHz]



15000 10000 1000

Frequency [MHz]

FCC 18 @ 1m
1-15 GHz, MICROWAVE OVEN
VERTICAL
RBW=1MHz, VBW=100Hz
SAMSUNG MODEL MW6886W

MICROWAVE OVEN AT 1M > 500W

140

120

100

80

60

1000

[dB(uV/meter)]

