CONTENTS

Underwriters Laboratories Inc., 1655 Scott Blvd., Santa Clara, CA 95050 USA
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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 selection of time duration. The maximum time duration setting is 15 minutes. The input electrical rating is 120 Vac, 60 Hz, 0.7 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.

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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/cm^2 observed at any point 5 cm or more from the external surface of the oven.

A maximum of 1.0 mW/cm^2 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	9.2	850

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

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2.3 RF OUTPUT POWER MEASUREMENT

The Caloric Method was used to determine maximum RF output power. 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	31	120

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

$$\text{Power} \quad \frac{(4.2) \times (1000) \times (10)}{12}$$

Power 350 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 μV/meter at a 300 meter measurement distance.

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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 competition of test: 200 ml.

Maximum frequency observed: 2481 MHz
Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2464 MHz
Minimum frequency allowed: 2400 MHz

Refer to data page 1 and 1A for details of the variation in operating frequency with time measurements.

2.4.2 VARIATION IN OPERATING FREQUENCY WITH LINE VOLTAGE

Immediately after the above test, after operating the oven long enough to assure that stable operating temperatures were obtained, the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The water load was maintained at 200ml for the duration of this test. The results of this test are as follows:

Line voltage varied from 96 Vac to 150 Vac.

Maximum frequency observed: 2473 MHz
Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2460 MHz
Minimum frequency allowed: 2400 MHz

Refer to data page 2 for details of the variation in operating frequency with line voltage measurements.

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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 10 meters for measurements from 100-1000 MHz, and at 1 meter for harmonic measurements, 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 are contained on data pages 7 through 14. Emissions were observed while the device under test was operated at maximum output power (only one setting provided).

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 3.

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. Harmonics, beyond the third were measured with a 700ml load placed in the center of the oven. The data obtained during these tests is contained on data pages 4 and 5.

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 6.

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

For frequencies above 1 GHz, the video bandwidth of the spectrum analyzer was set to simulate a linear average detection mode.

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.

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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, and Model 85685A RF Preselector, S/N 3506A01538, Cal Date 11-24-97.
- Holiday, Microwave Leakage Meter, Model 1500, S/N 10012, Cal. Date 05-16-96 due 05-16-98.
- Doric Scientific, Digital Temperature Indicator, Model 400A, S/N 31484, Cal. Date 08-26-97.
- 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

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International EMC Services

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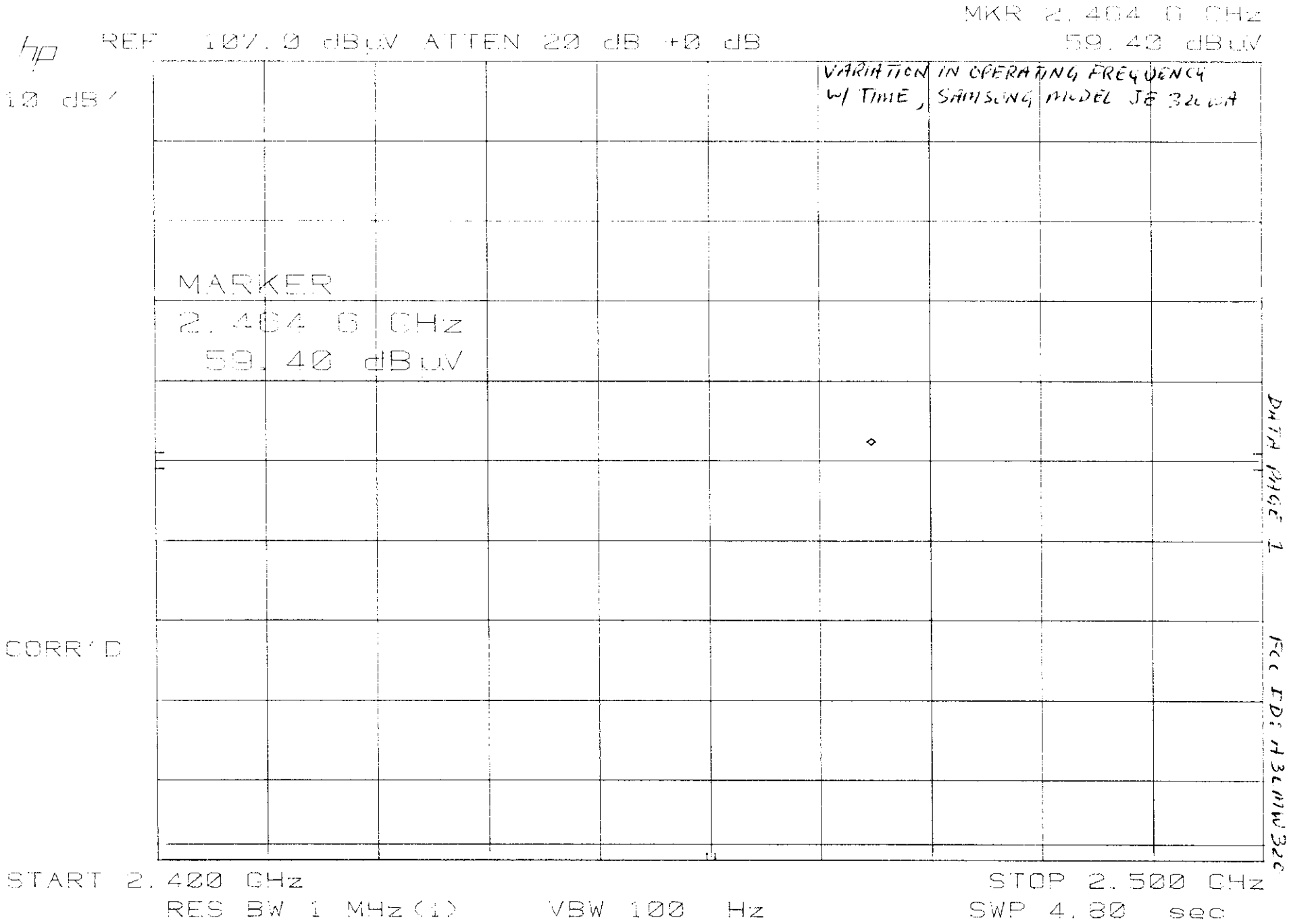
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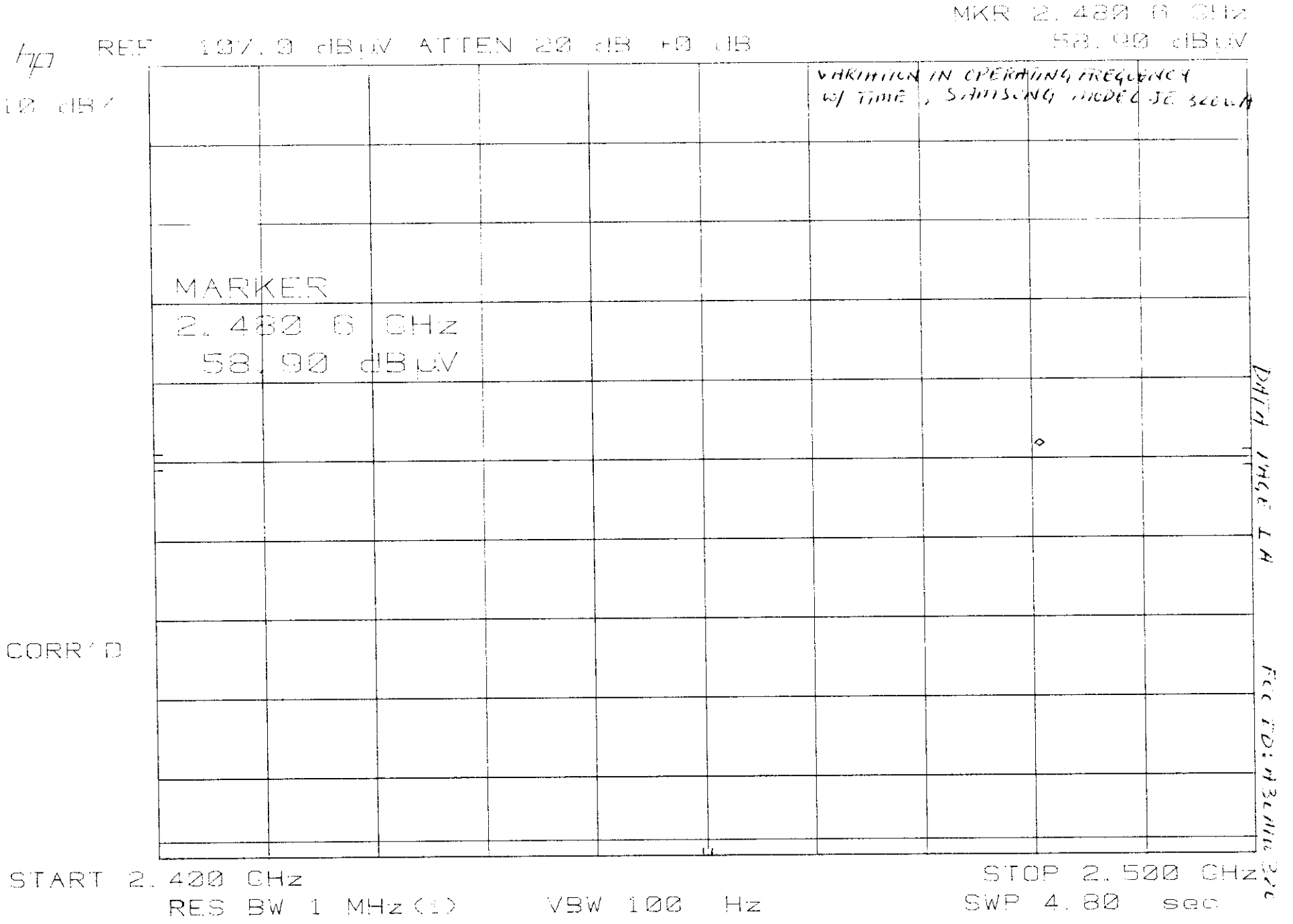
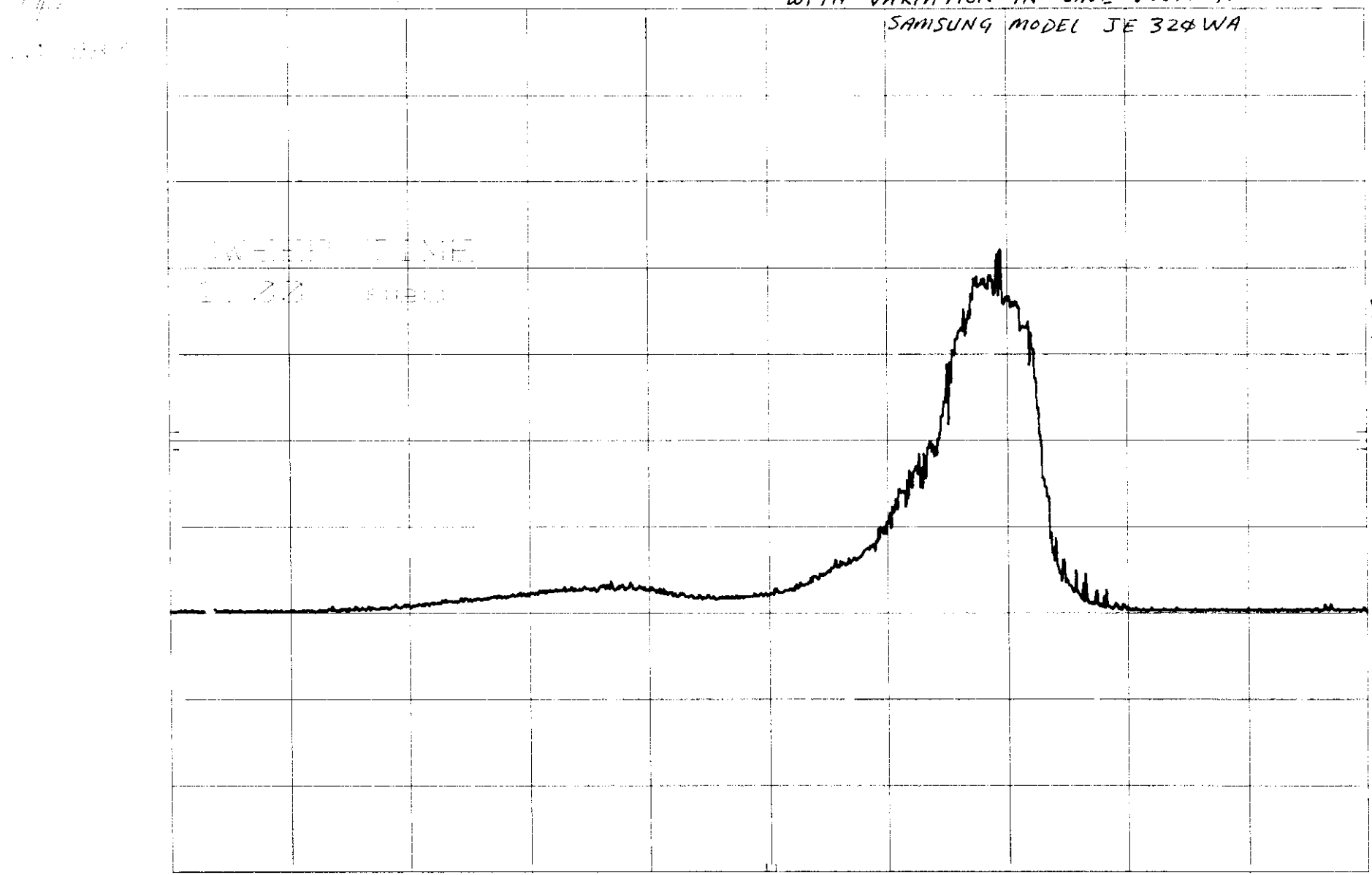
59.43 dBuV
REF 107.0 dBuV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN OPERATING FREQUENCY
W/ TIME, SAMSUNG MODEL SF-32CWA
MARKER
2.404 0 GHz
59.40 dBuV
CORR'D
START 2.400 GHz
STOP 2.500 GHz
RES BW 1 MHz (I)
VBW 100 Hz
SWP 4.80 sec
DATA PAGE 1
FCC ID: A3LMW32C


MKR 2.480 0 GHz
58.90 dBµV
REF 137.9 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN OPERATING FREQUENCY
W/ TIME, SAMSUNG MODEL SGH-X426
MARKER
2.480 0 GHz
58.90 dBµV
CORR'D
START 2.400 GHz
RES BW 1 MHz (I)
VBW 100 Hz
STOP 2.500 GHz
SWP 4.80 sec

VARIATION IN OPERATING FREQUENCY
WITH VARIATION IN LINE VOLTAGE
SAMSUNG MODEL JE 320WA



DATA PAGE 2

FCC ID: A3LMW320

UNDERWRITERS LABORATORIES INC.
ISM SIDEBAND MEASUREMENTS
Data Page 3

Date Tested: March 18, 1998

Manufacturer:	Samsung Electronics America, Inc.
Product Type:	Microwave oven
Model:	JE 320WA
Magnetron:	Samsung, Model OM-52S
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:	3 meter
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]
2 399 H	27.8	1.0	30.3	59.1	9.0	25
2 501 V	25.5	1.0	30.5	57.0	7.1	25

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 x 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]

UNDERWRITERS LABORATORIES INC.
HARMONIC MEASUREMENTS
Data Page 4

Date Tested: March 21, 1998

Manufacturer:	Samsung Electronics America, Inc.
Product Type:	Microwave oven
Model:	JE 320WA
Magnetron:	Samsung, Model OM-52S
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						
4 942 V	16.4	1.4	33.3	51.1	1.2	25
7 409 H	23.7	1.7	36.9	62.3	4.3	25
9 883 H	25.9	2.0	37.8	65.7	6.4	25
12 349 V	22.2	2.4	39.3	63.9	5.2	25
Load: 700 ml water in right front corner of oven						
4 934 H	14.8	1.4	33.4	49.6	1.0	25
7 407 H	23.1	1.7	36.9	61.7	4.1	25

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 x 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]

UNDERWRITERS LABORATORIES INC.
HARMONIC MEASUREMENTS
Data Page 5

Date Tested: March 21, 1998

Manufacturer:	Samsung Electronics America, Inc.
Product Type:	Microwave oven
Model:	JE 320WA
Magnetron:	Samsung, Model OM-52S
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: 300 ml water in center of oven						
4 923 H	18.1	1.4	33.4	52.9	1.5	25
7 408 H	25.8	1.7	36.9	64.4	5.5	25
Load: 300 ml water in right front corner of oven						
4 906 H	19.8	1.4	33.4	54.6	1.8	25
7 383 H	22.4	1.7	36.9	61.0	3.7	25

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 x 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]

UNDERWRITERS LABORATORIES INC.
OUT-OF-BAND EMISSIONS MEASUREMENTS
Data Page 6

Date Tested: March 18 and April 6, 1998

Manufacturer:	Samsung Electronics America, Inc.
Product Type:	Microwave oven
Model:	JE 320WA
Magnetron:	Samsung, Model OM-52S
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., Biconical Model EM6912A, S/N 126 and Log-Periodic Model EM6950, S/N 935
Measurement Distance:	10 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)	10 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
272.6 H	8.0	1.9	12.8	22.7	1	25
547.9 H	8.0	2.7	17.2	27.9	1	25
617.3 H	7.3	2.9	18.3	28.5	1	25
925.9 H	7.4	3.8	22.0	33.2	2	25

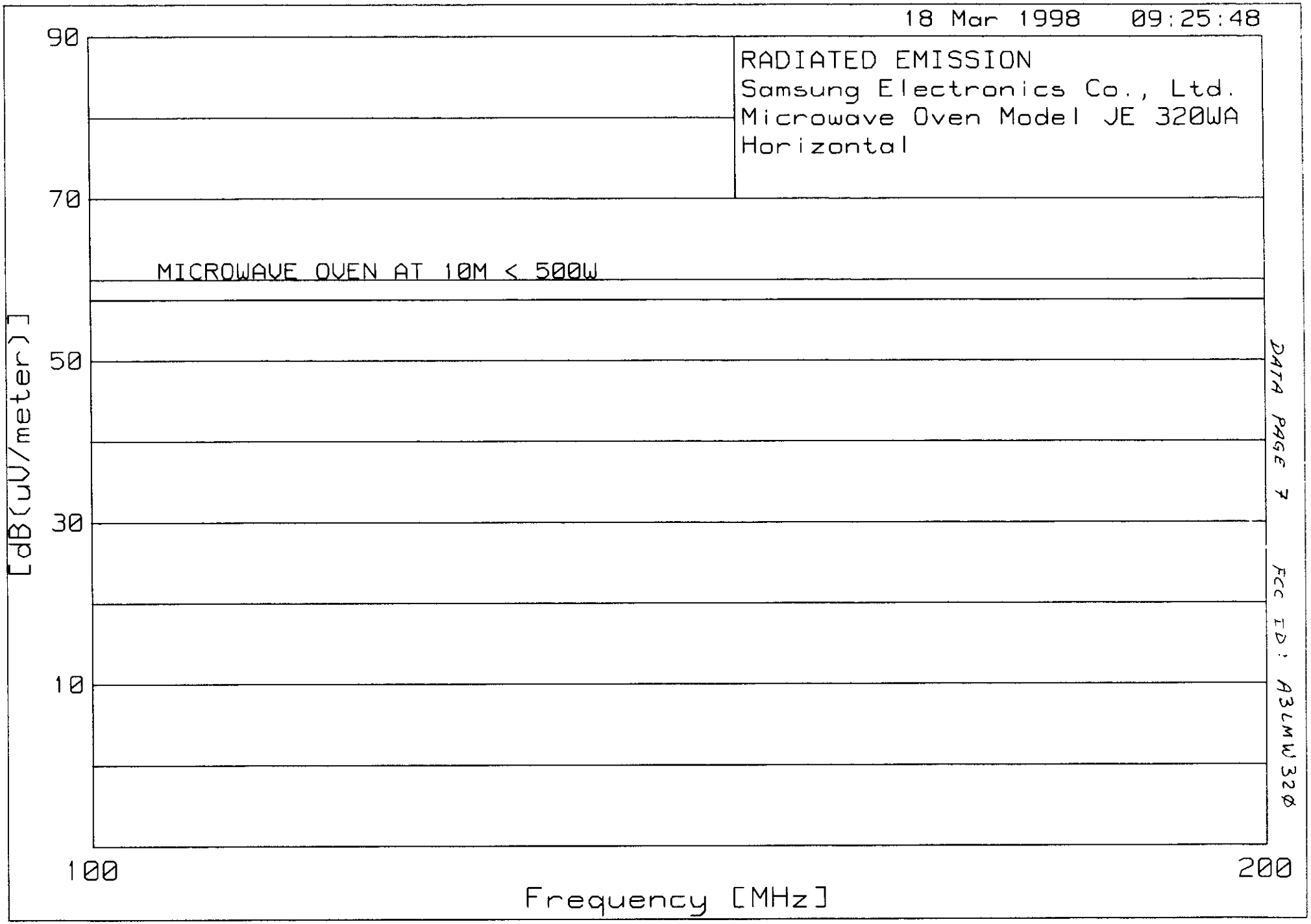
Measured Frequency (Mhz)	Meter Reading (dB(μV))	Cable Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
2 748 V	26.1	1.6	28.3	56.0	2.1	25
5 535 H	18.3	2.5	35.4	56.2	2.2	25
7 126 H	19.6	3.1	36.4	59.1	3.0	25
11 531 H	20.6	4.4	39.5	64.5	5.6	25

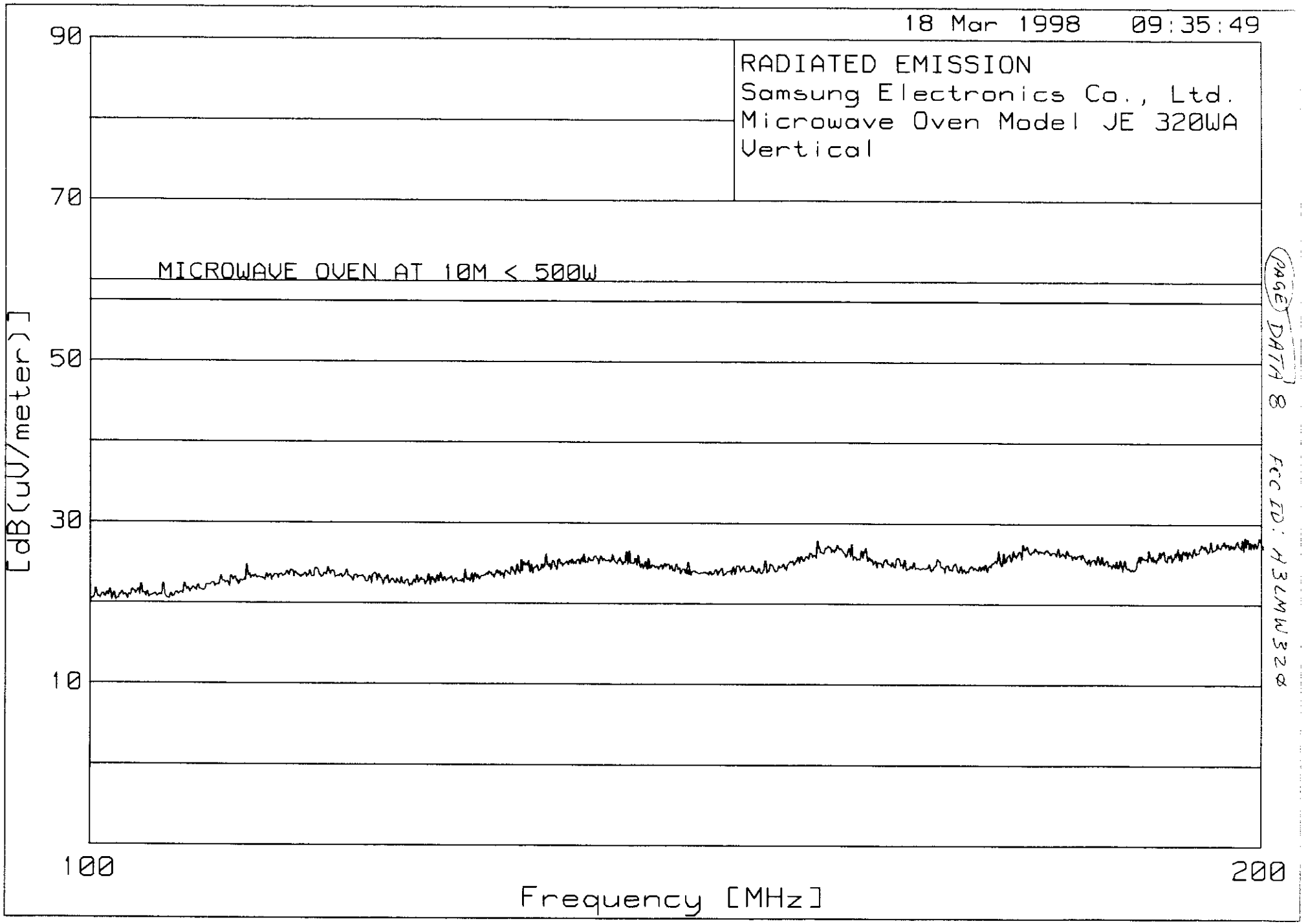
V - indicates vertical antenna polarity; H - indicates horizontal antenna polarity.

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 x 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]


18 Mar 1998 09:25:48
RADIATED EMISSION
Samsung Electronics Co., Ltd.
Microwave Oven Model JE 320WA
Horizontal
MICROWAVE OVEN AT 10M < 500W
90
70
50
30
10
[dB(uV/meter)]
100
200
Frequency [MHz]
DATA PAGE 7
FCC ID: A3LMW320



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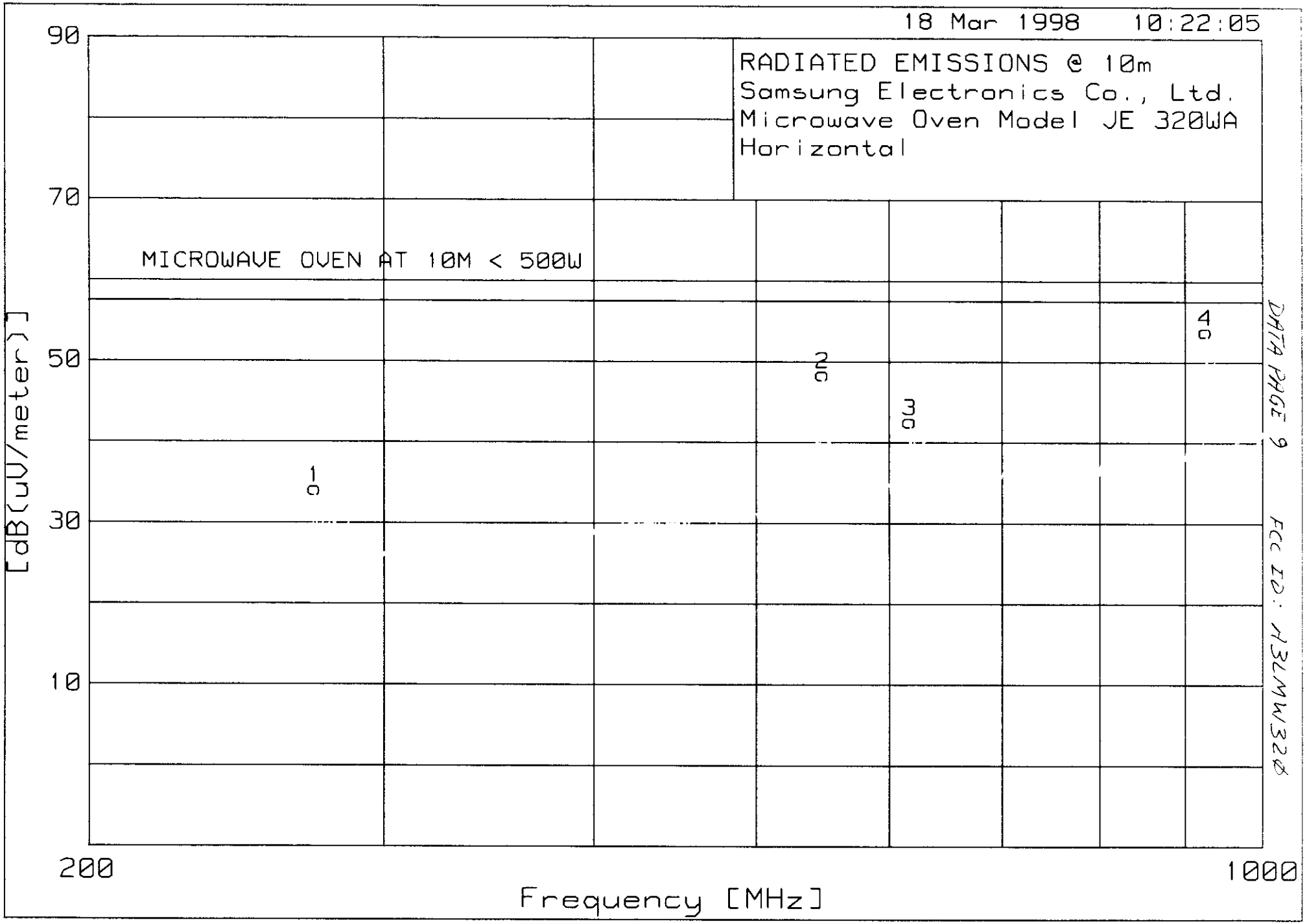
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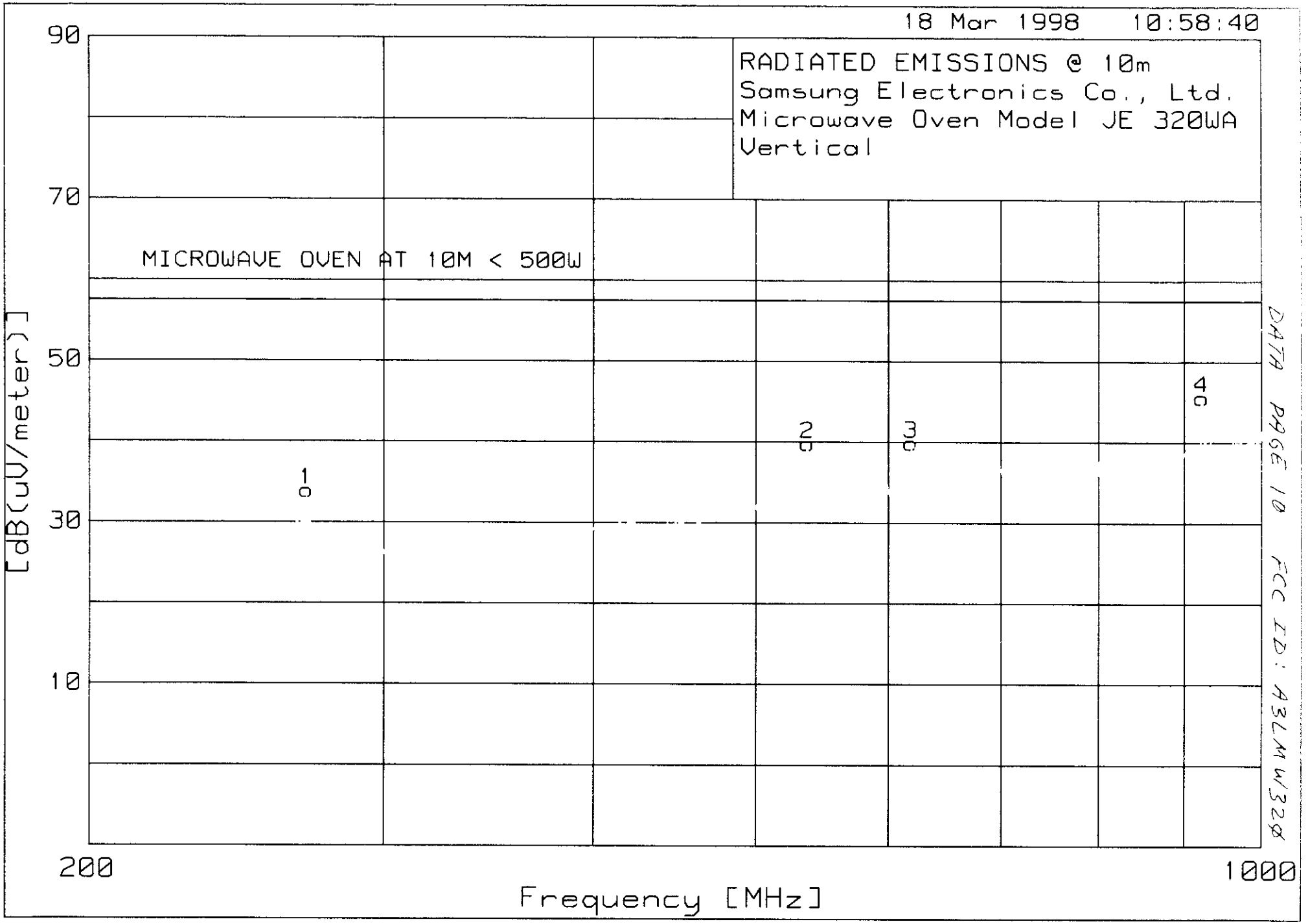
Samsung Electronics Co., Ltd.
Microwave Oven Model JE 320WA
Horizontal
MICROWAVE OVEN AT 10M < 500W
90
70
50
30
10
[dB(uV/meter)]
200
1000
Frequency [MHz]
1
2
3
4
DATA PAGE 9
FCC ID: A32MW320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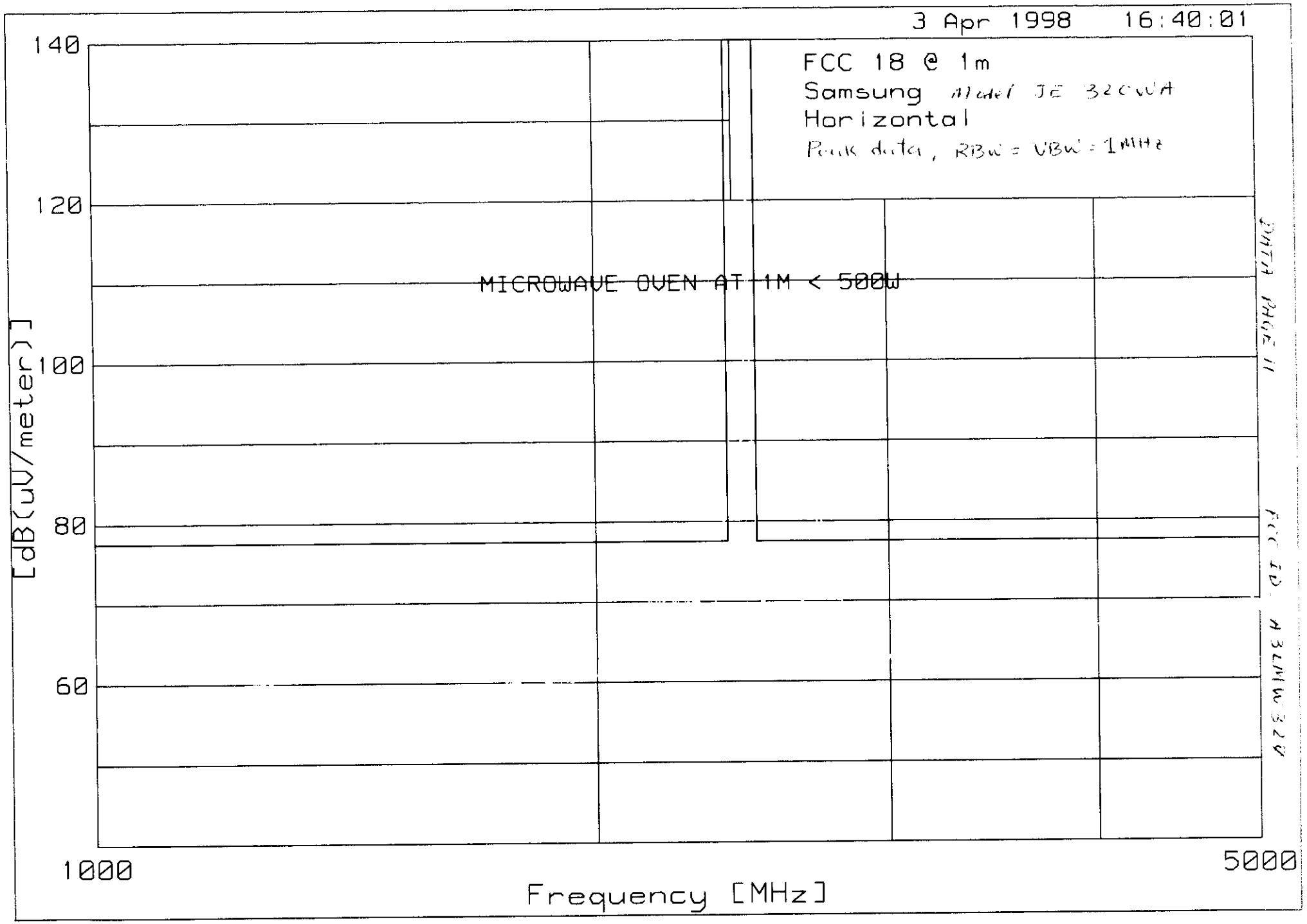
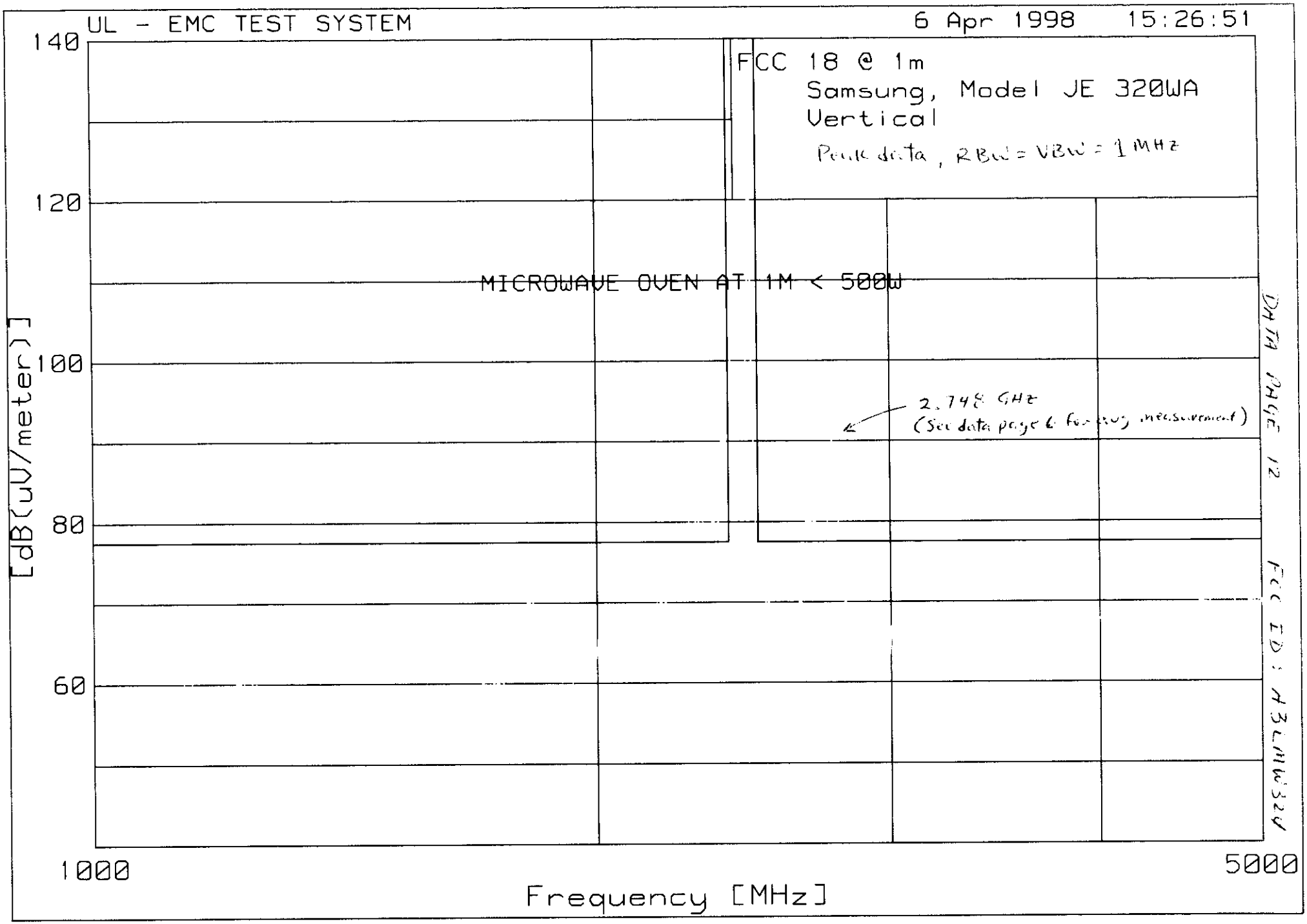
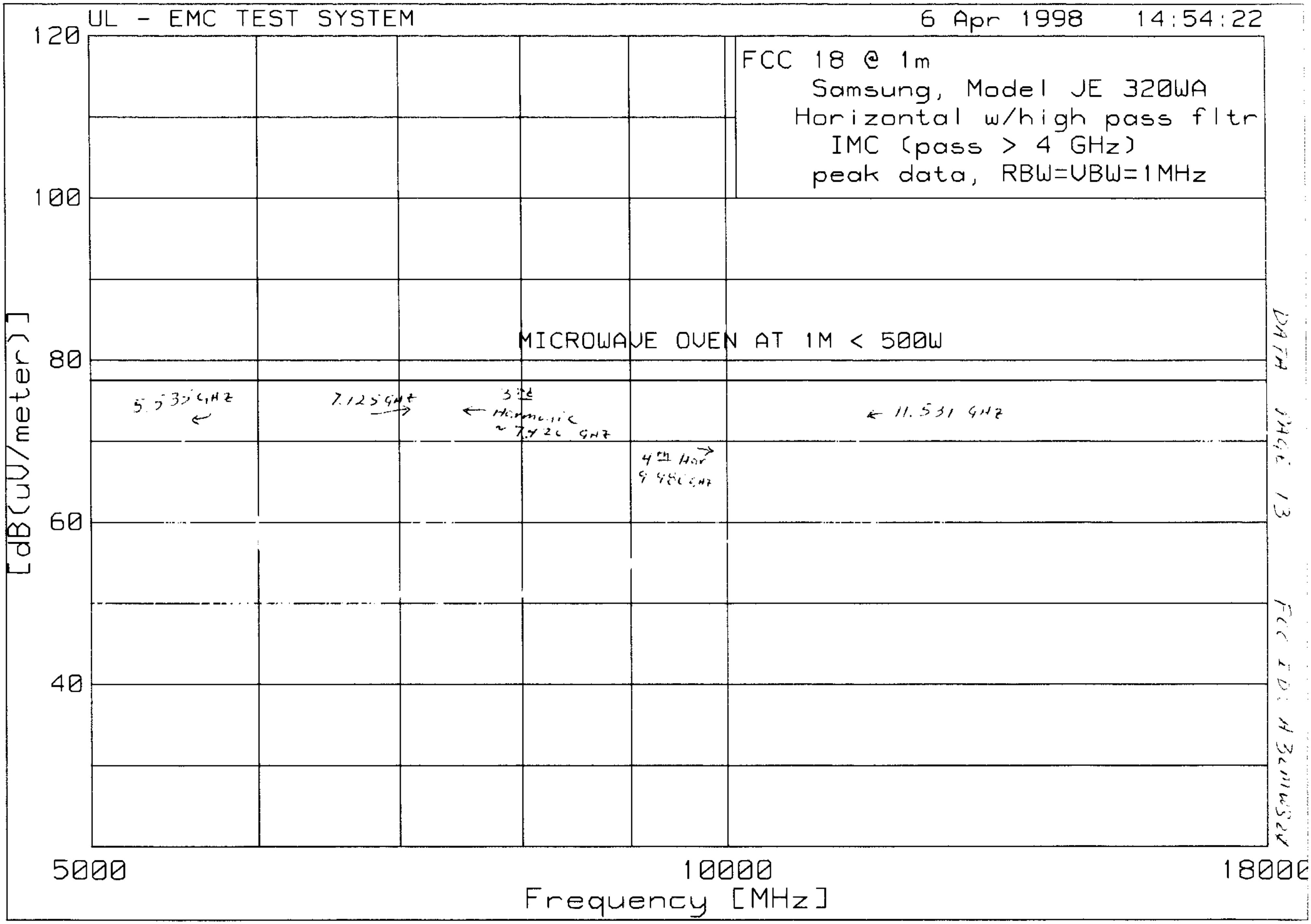
RADIATED EMISSIONS @ 10m
Samsung Electronics Co., Ltd.
Microwave Oven Model JE 320WA
Vertical
MICROWAVE OVEN AT 10M < 500W
90
70
50
30
10
[dB(uV/meter)]
200
1000
Frequency [MHz]
1
2
3
4
DATA PAGE 10 FCC ID: A3LMW320


3 Apr 1998 16:40:01
FCC 18 @ 1m
Samsung Model JE 32CWA
Horizontal
Peak data, RBW = VBW = 1MHz
MICROWAVE OVEN AT 1M < 500W
DATA PAGE 11
FCC ID: A3LMW32V
140
120
100
80
60
[dB(uV/meter)]
1000
5000
Frequency [MHz]


UL - EMC TEST SYSTEM
6 Apr 1998 15:26:51
FCC 18 @ 1m
Samsung, Model JE 320WA
Vertical
Peak data, RBW = VBW = 1 MHz
MICROWAVE OVEN AT 1M < 500W
2.748 GHz
(See data page 6 for freq measurement)
DATA PAGE 12
FCC ID: A3LMW320
140
120
100
80
60
[dB(uV/meter)]
1000
5000
Frequency [MHz]


UL - EMC TEST SYSTEM
6 Apr 1998 14:54:22
FCC 18 @ 1m
Samsung, Model JE 320WA
Horizontal w/high pass fltr
IMC (pass > 4 GHz)
peak data, RBW=VBW=1MHz
MICROWAVE OVEN AT 1M < 500W
5.533 GHz
7.125 GHz
3rd Harmonic ~7.42 GHz
4th Har 9.98 GHz
11.531 GHz
120
100
80
60
40
[dB(uV/meter)]
5000
10000
18000
Frequency [MHz]
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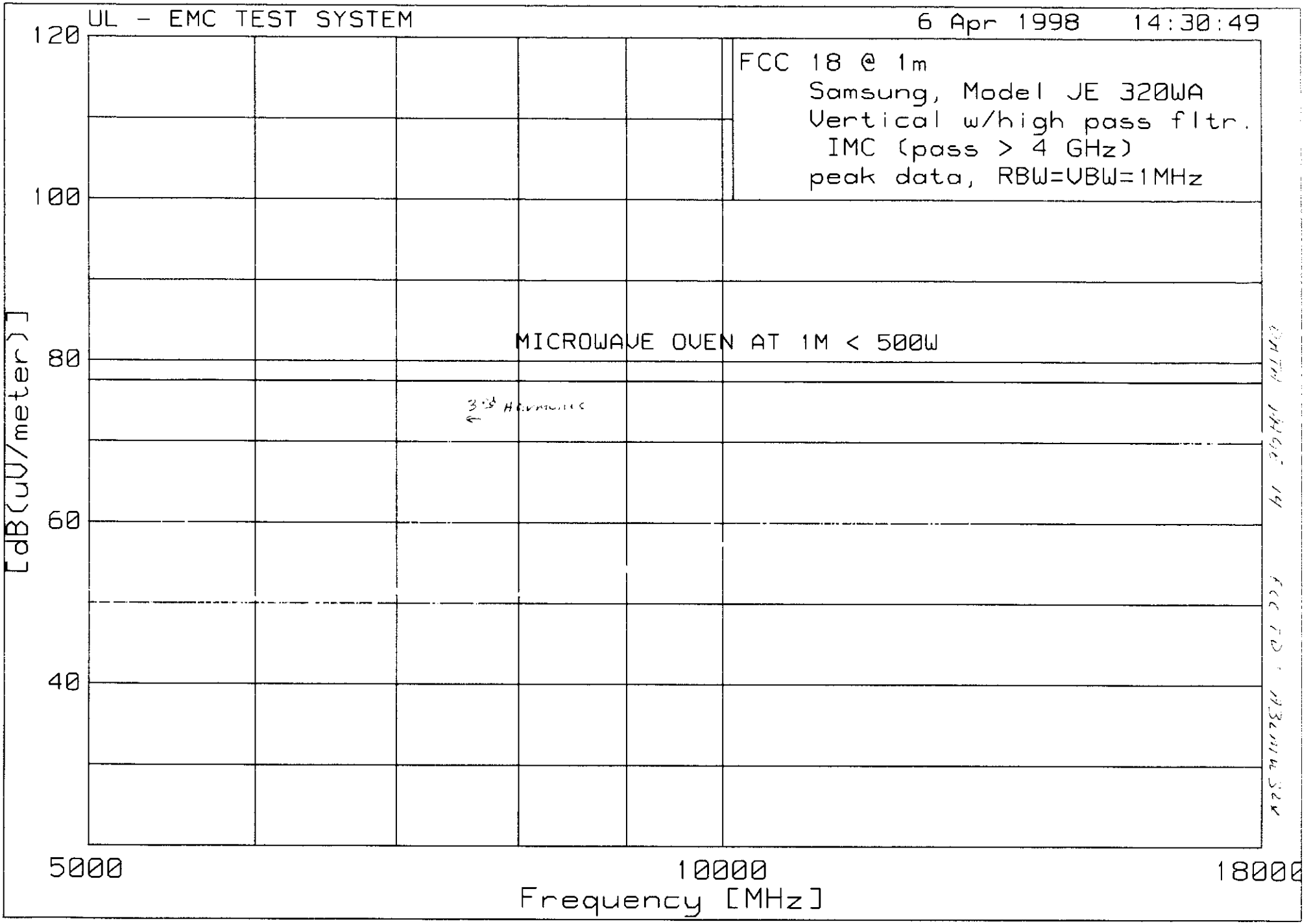
FCC ID: A3LMW520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6 Apr 1998 14:30:49
FCC 18 @ 1m
Samsung, Model JE 320WA
Vertical w/high pass fltr.
IMC (pass > 4 GHz)
peak data, RBW=VBW=1MHz
MICROWAVE OVEN AT 1M < 500W
120
100
80
60
40
[dB(uV/meter)]
5000
10000
18000
Frequency [MHz]

CLEAR
OFF
POPCORN
MIX
PIZZA