

FCC MEASUREMENT / TECHNICAL TEST REPORT

SAMSUNG ELECTRONICS CO., LTD.

MICROWAVE OVEN MODEL MG7980W

WITH SAMSUNG MAGNETRON OM-75P

FILE: NC2425
PROJECT: 98SC08212
ISSUED: June 24, 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 MG7980W
with Samsung Magnetron Model OM-75P
REPORT PREPARED BY: Underwriters Laboratories, Inc.
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This report contains 8 pages + 11 data pages. Page 1 of 8

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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 with a grill feature. 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 99 seconds. Maximum power level setting is 9 (100%). The input electrical rating is 120 Vac, 60 Hz, 1.4 kW. The RF Power Output is rated at 930 W.

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 at 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)	Rated Input Power (watts)
117.68	13.800A	1.4922 kW	1.4 kW

- ☒ 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	23.0	45.0	120

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

$$\text{Power} = \frac{(4.2) \times (1000) \times (22)}{120}$$

$$\text{Power} = \boxed{770 \text{ watts}}$$

- ☐ 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:

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

where: L_{fs} 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 **31 $\mu\text{V}/\text{meter}$** . [31 $\mu\text{V}/\text{m} = 29.8 \text{ dB}(\mu\text{V}/\text{m})$]
 [29.8 $\text{dB}(\mu\text{V}/\text{m})$ @ 300m = 69.8 $\text{dB}(\mu\text{V}/\text{m})$ @ 3m]
 [29.8 $\text{dB}(\mu\text{V}/\text{m})$ @ 300m = 79.3 $\text{dB}(\mu\text{V}/\text{m})$ @ 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: 2467 MHz

Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2456 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: 2467 MHz

Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2457 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: 98SC08212
MODEL: MG7980W
ISSUED: June 24, 1998

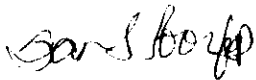
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3.0 MEASUREMENT EQUIPMENT:

The test equipment used for these measurements includes:

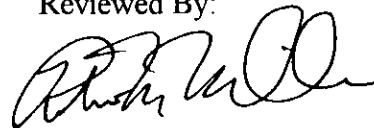
- Hewlett Packard, EMI Receiving System: Model 8566B Spectrum Analyzer S/N 3638A08593, Model OPT Spectrum Analyzer Display S/N 3552A22050, Model 85650A Quasi-Peak Adapter S/N 3303A01831, Model 85685A RF Preselector, S/N 3506A01538, Cal Date 11-24-97, and Model 8449B Preamplifier, S/N 3008A00884, Cal Date 11-24-97.
- 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

FILE: NC2425
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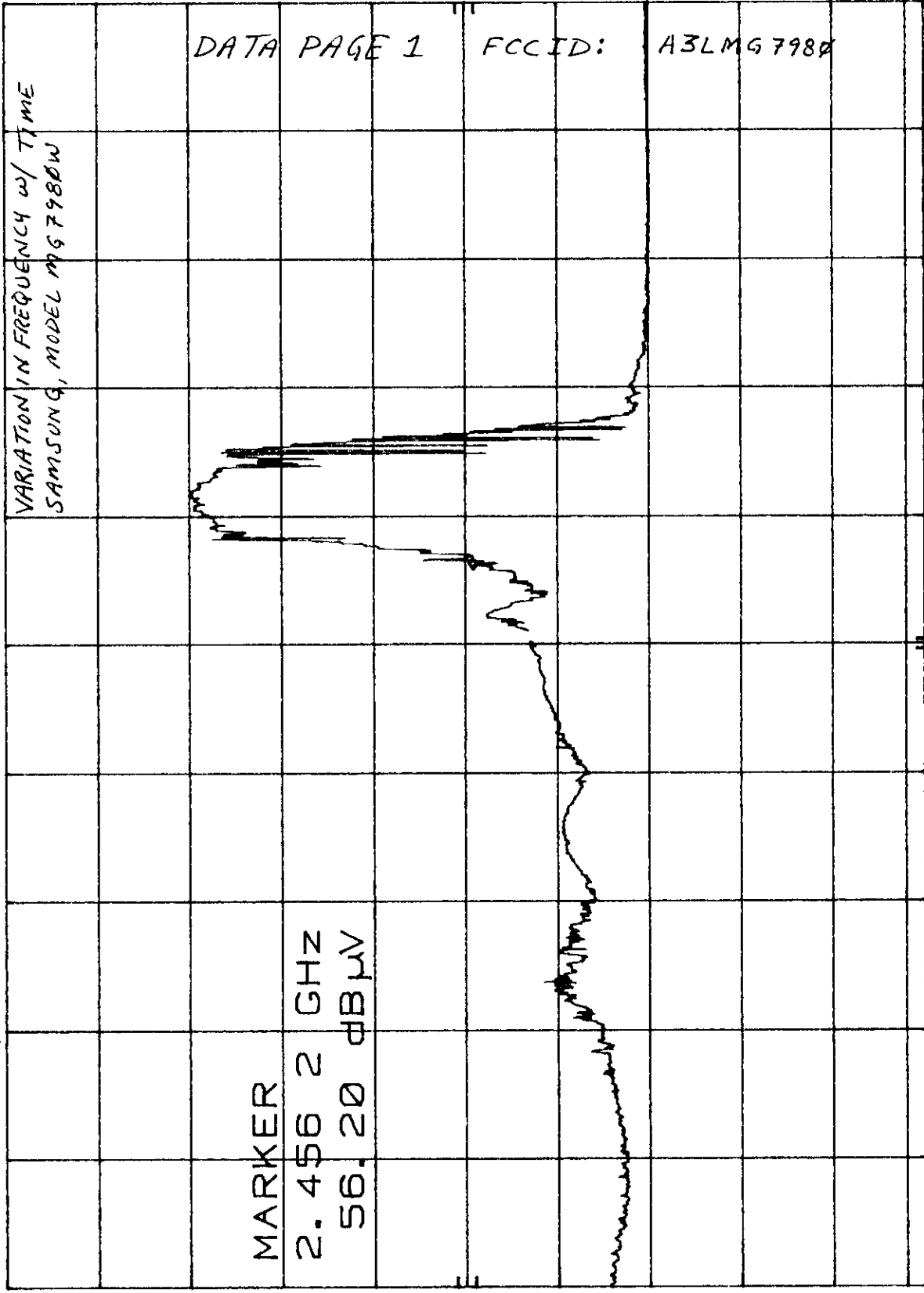
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4.0 Test Data

Pages 1-11

h_p MKR 2.456 2 GHz
10 dB/ 56.20 dBμV

REF 107.0 dBμV ATTEN 20 dB +0 dB



START 2.400 GHz
RES BW 1 MHz (1)

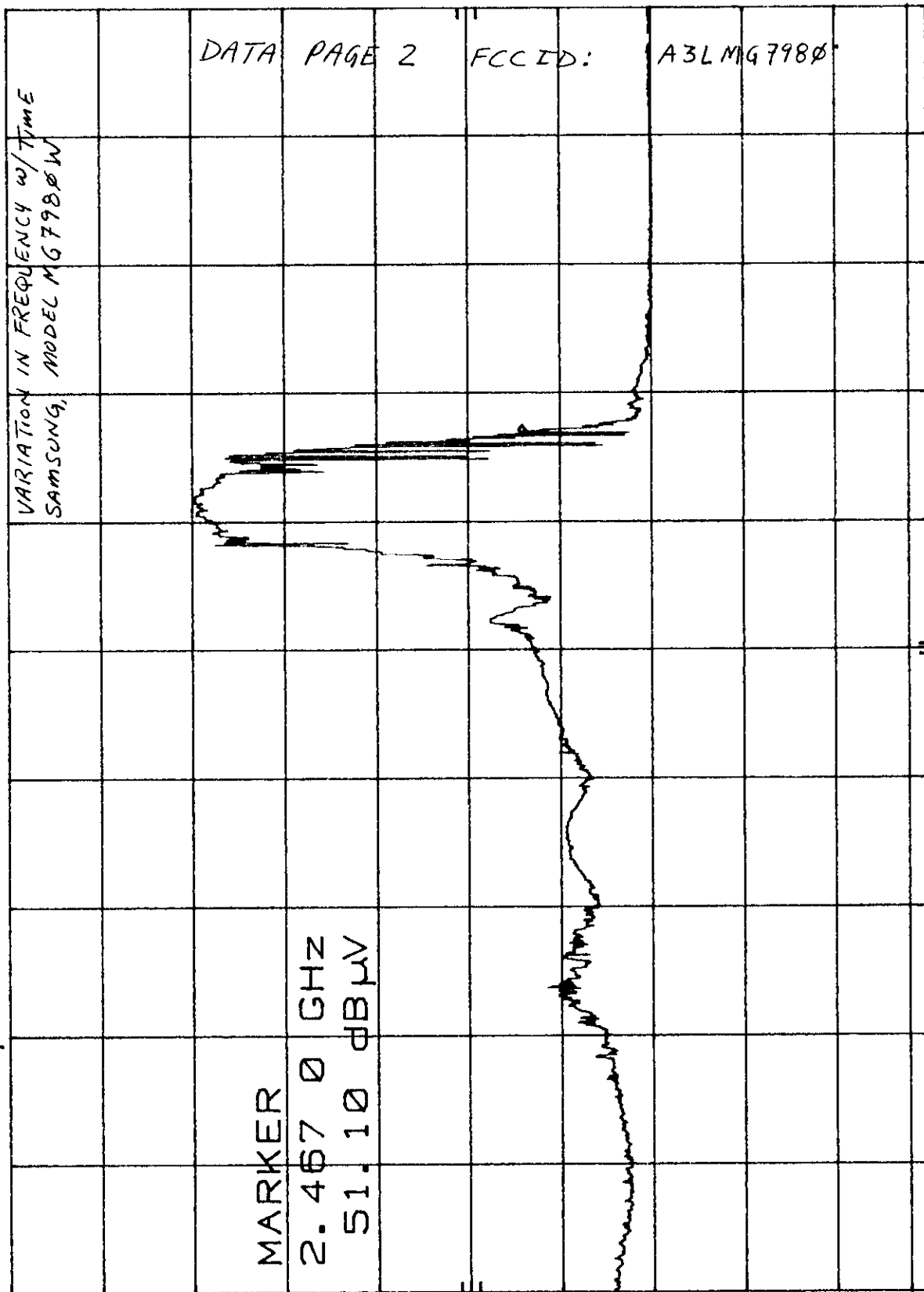
STOP 2.500 GHz
SWP 10.0 sec

VBW 100 Hz

MKR 2.467 0 GHz
51.10 dBμV

hp REF 107.0 dBμV ATTN 20 dB +0 dB

10 dB/



CORR'D

START 2.400 GHz
RES BW 1 MHz (1)
STOP 2.500 GHz
SWP 10.0 sec
VBW 100 Hz

h_p REF 107.0 dBμV ATTN 20 dB +0 dB

10 dB/

MARKER
2.457 2 GHz
57.20 dBμV

VARIATION IN OPERATING FREQUENCY
w/ VARIATION IN LINE VOLTAGE
SAMSUNG, MODEL M6798W

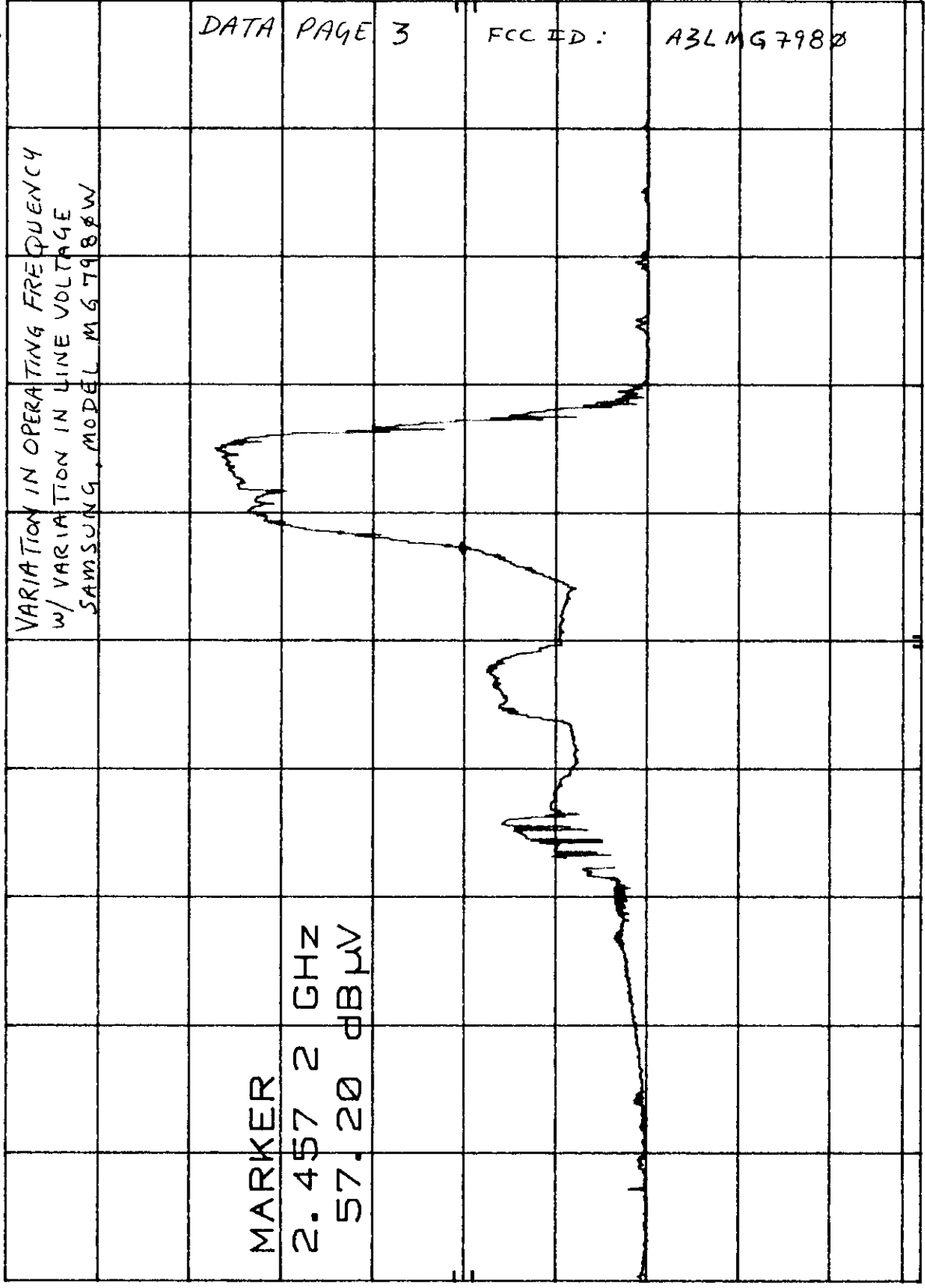
DATA PAGE 3

FCC ID:

A3LMG7980

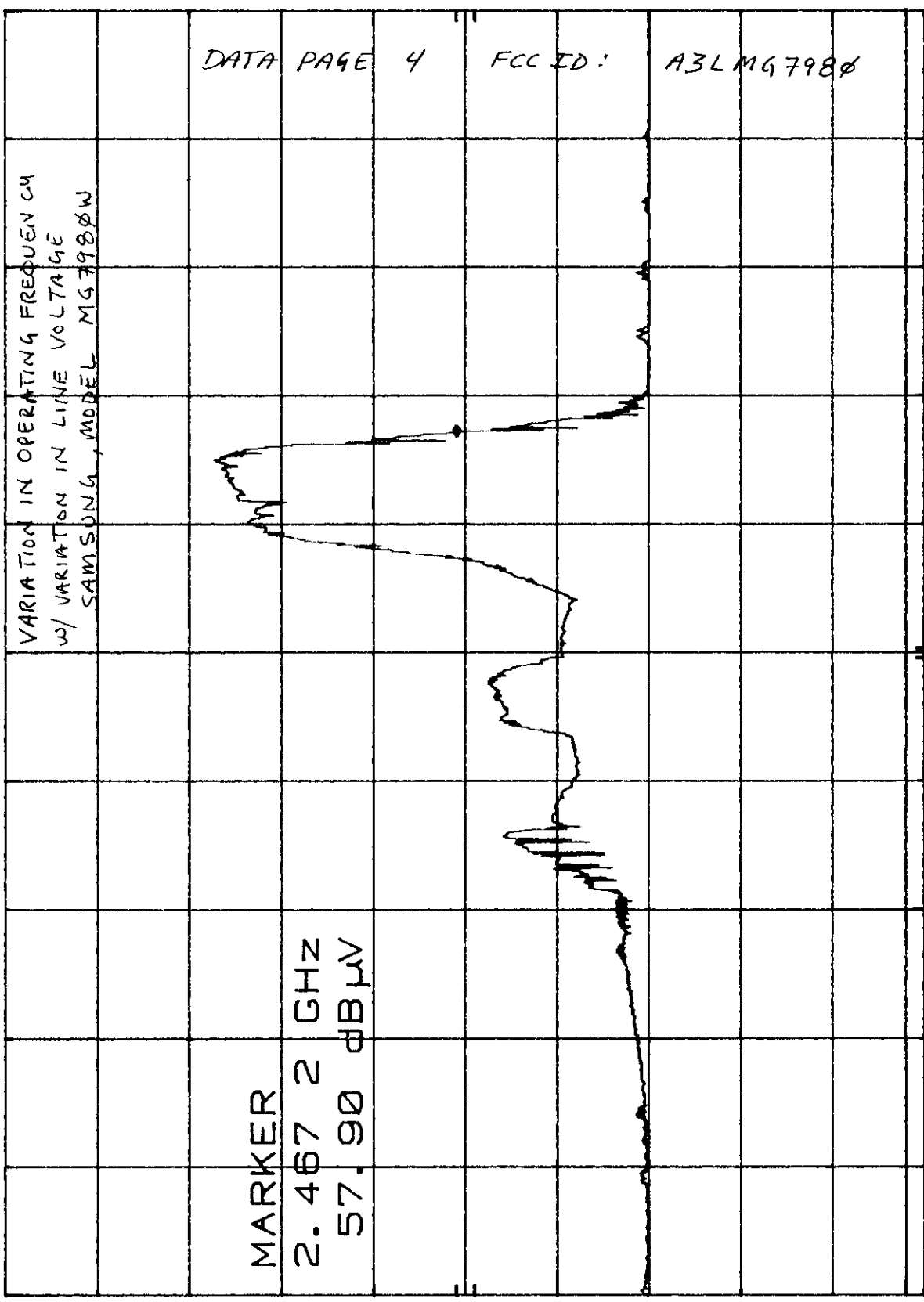
CORR'D

START 2.400 GHz
RES BW 1 MHz (1)
STOP 2.500 GHz
SWP 10.0 sec



HP MKR 2.467 2 GHz
10 dB/ 57.90 dBμV

REF 107.0 dBμV ATTEN 20 dB +0 dB



DATA PAGE 4 FCC ID: A3LMG7980

START 2.400 GHz STOP 2.500 GHz
RES BW 1 MHz(1) SWP 10.0 sec
VBW 100 Hz

FILE: NC2425
PROJECT: 98SC
MODEL: MG7980W
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FCC ID: A3LMG7980

UNDERWRITERS LABORATORIES INC.
ISM SIDEBAND MEASUREMENTS
Data Page 5

Date Tested: June 23, 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., Ridged Guide Horn, 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]
2399 V	17.5	4.2	28.7	50.4	1	31
2399 H	17.5	4.2	28.7	50.4	1	31
2501 V	15.8	4.6	28.9	49.3	1	31
2501 H	15.9	4.6	28.9	49.4	1	31

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: 98SC
 MODEL: MG7980W
 ISSUED: June 24, 1998

FCC ID: A3LMG7980

UNDERWRITERS LABORATORIES INC.
 HARMONIC MEASUREMENTS
 Data Page 6

Date Tested: June 23, 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						
4.924 H	20.3	6.8	34.4	61.5	4	31
7391 H	21.3	9.0	36.6	66.9	7	31
Load: 700 ml water in right front corner of oven						
4907 H	16.2	6.8	34.4	57.4	3	31
7344 H	20.6	8.6	36.6	66.1	7	31
Load: 300 ml water in center of oven						
4925 H	19.5	6.8	34.4	60.7	4	31
7388 H	22.8	8.9	36.6	68.3	9	31
Load: 300 ml water in right front corner of oven						
4925 H	16.9	6.8	34.4	58.1	3	31
7376 V	21.2	8.9	36.6	66.7	7	31

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.

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

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]

FILE: NC2425
 PROJECT: 98SC
 MODEL: MG7980W
 ISSUED: June 24, 1998

FCC ID: A3LMG7980

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

Date Tested: June 23, 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]
226 V	-3.9	1.6	11.1	8.8	1	31
767 V	-0.6	3.2	20.2	22.8	1	31

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]
None - only 2nd and 3rd Harmonics were detected.						

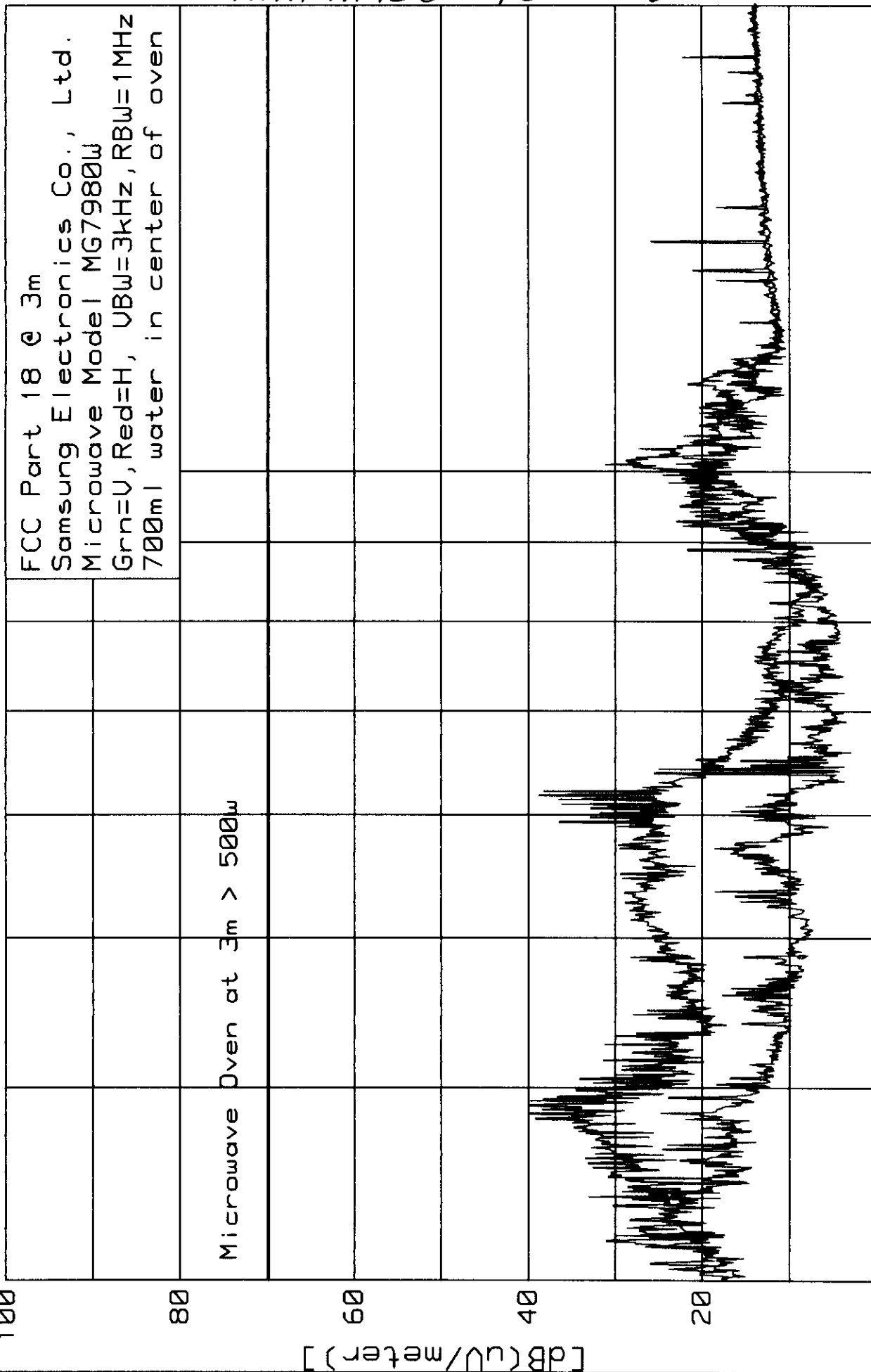
V - indicates vertical antenna polarity; H - indicates horizontal antenna polarity.

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.

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

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]

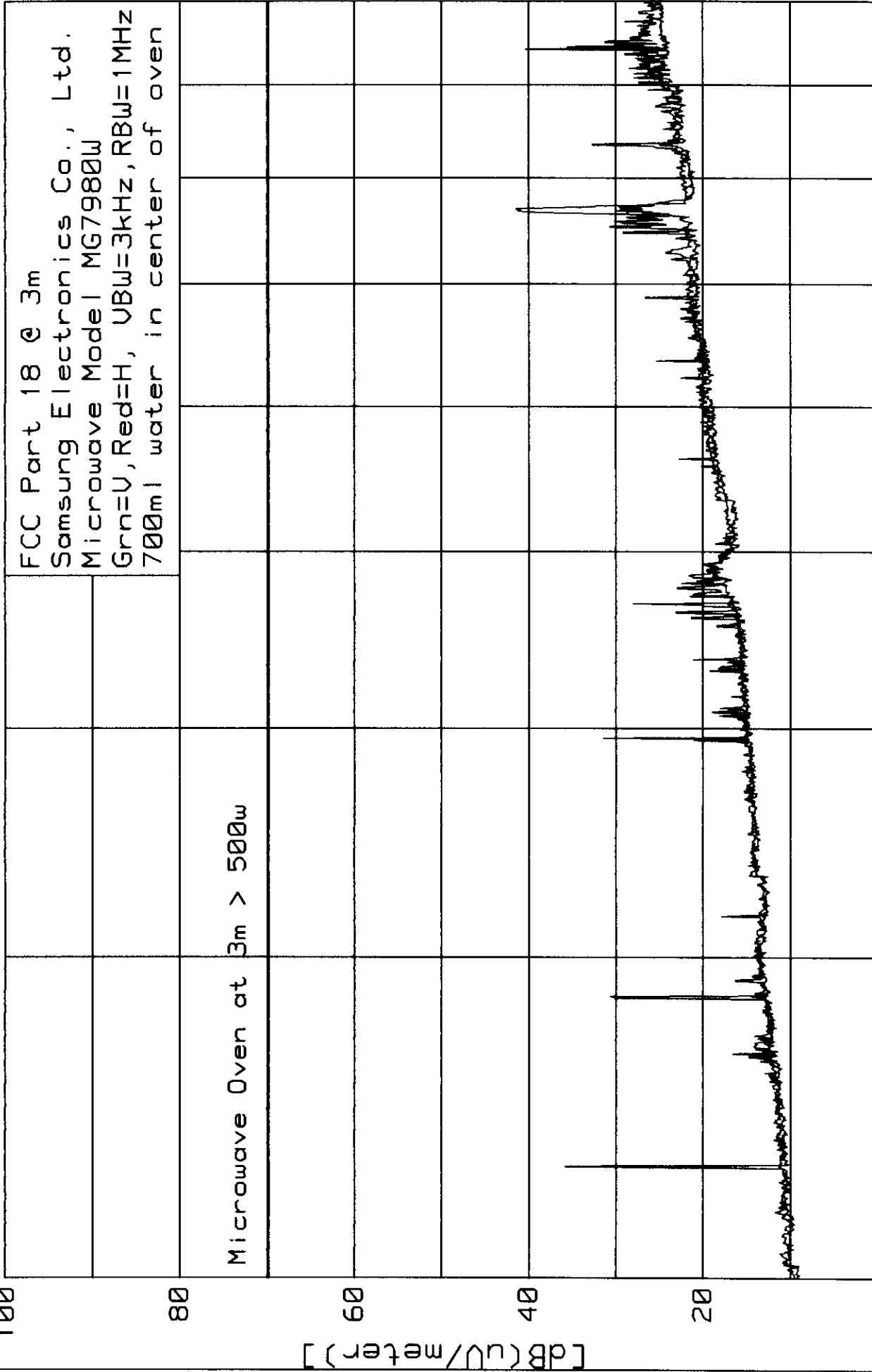
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30

100

200



200

Frequency [MHz]

1000

FCC Part 18 @ 1m
Samsung Electronics Co., Ltd.
Microwave Model MG7980W
Horizontal
RBW=1MHz, VBW=100Hz

[dB(uV/meter)]

MICROWAVE OVEN AT 1M > 500W

Frequency [MHz]

140

120

100

80

60

1000

10000

15000

FCC 18 @ 1m
Samsung Electronics Co., Ltd.
Microwave Model MG7980W
Vertical
RBW=1MHz, VBW=100Hz

[dB(uV/meter)]

MICROWAVE OVEN AT 1M > 500W

Frequency [MHz]

140

120

100

80

60

1000

10000

15000