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FCC MEASUREMENT / TECHNICAL TEST REPORT

Samsung Electronics America, Inc.

Microwave Oven Model MW4592W

With Magnetron Samsung, Model OM-75S

FILE: NC2425
PROJECT: 98SC43385
ISSUED: September 28, 1998
FCC ID: A3L3RD4592

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 MW4592W
with Magnetron Samsung, Model OM-75S

REPORT PREPARED BY: Underwriters Laboratories, Inc.
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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 99:99 (minutes:seconds). Maximum power level setting is 9 (100%). The input electrical rating is 120 Vac, 60 Hz, 1.15 kW. The RF Power Output is rated at 700 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:

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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 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.

(maximum observed values)

Input Voltage (Vac)	Input Current (amps)	Measured Input power (watts)	Rated Input Power (watts)
120	11.6	1170	1150

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

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2.3 LOAD FOR MICROWAVE OVENS

For all measurements the energy developed by the oven was absorbed by a dummy load consisting of a quantiy of tap water in a beaker. If the oven was provided with a shelf or other utensil support, this support was in its initial normal position. For ovens rated at 1000 watts or less power output, the beaker contained quantities of water as listed in the following subparagraphs. For ovens rated at more than 1000 watts output, each quantity was increased by 50% for each 500 watts or fraction thereof in excess of 1000 watts. Additional beakers were used if necessary.

-- Load for power output measurement: 1000 milliliters of water in the beaker located in the center of the oven.

-- Load for frequency measurement: 1000 milliliters of water in the beaker located in the center of the oven.

-- Load for measurement of radiation on second and third harmonic: Two loads, one of 700 and the other of 300 milliliters, of water are used. Each load is tested both with the beaker located in the center of the oven and with it in the right front corner.

-- Load for all other measurements: 700 milliliters of water, with the beaker located in the center of the oven.

The RF output power is rated at 700 watts.

Load used for power output measurement = 1000 milliliters of water

Load used for frequency measurements = 1000 milliliters of water

Load used harmonic measurements = 700 & 300 milliliters of water

Load used for all other measurements = 700 milliliters of water

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2.4 RF OUTPUT POWER MEASUREMENT

The Caloric Method was used to determine maximum RF output power. The initial temperature of the 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.

Quantiy of Water (ml)	Starting Temperature (°C)	Final Temperature (°C)	Elapsed Time (seconds)
1000	24.0	38.0	120

$$\text{Power} = \frac{(4.2 \text{ joules/calorie})(\text{volume in milliliters})(\text{temperature rise})}{\text{time in seconds}}$$

Power = 490 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.

25 µV/meter = 27.9 dB (µV/m) @ 300m
67.9 dB (µV/m) @ 3m
77.5 dB (µV/m) @ 1m

☐ 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*SQRT(Power Output/500)

where: L_{FS} is the maximum allowable field strength for out-of-band emissions in µV/meter at a 300 meter measurement distance. Power Output is the measured output power in watts.

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2.5 OPERATING FREQUENCY MEASUREMENTS

2.5.1 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:

Maximum frequency observed: 2465 MHz
Maximum frequency allowed: 2500 MHz

Minimum frequency observed: 2440 MHz
Minimum frequency allowed: 2400 MHz

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

2.5.2 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: 2469 MHz
Maximum frequency allowed: 2500 MHz

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

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

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2.6 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 100-1000 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. Emissions were observed while the device under test was operated at maximum output power. Maximum readings were recorded after variations in antenna polarization, height, device orientation, load position and size.

Preliminary Test Data - see plots on data pages 8 through 10.

ISM Side Measurements - see date page 5.

Harmonic Measurements - see data page 6.

Out of Band Measurements - see data page 7.

☒ **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:

- **EMI Receiving System:** Hewlett Packard Co., 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, and Model 8449B Preamplifier, S/N 3008A00884, Cal Date 11-24-97.
- **Biconnical Antenna:** lectro-Metrics Inc. Model EM-6912A, S/N 126, Cal. Date 10-04-97.
- **Log Periodic Antenna:** Electro-Metrics Inc. Model EM-6950, S/N 935, Cal. Date 10-04-97.
- **Horn Rigid Guide Antenna:** Electro-Metrics Inc. Model EM-6961, S/N 6275, Cal. Date 09-23-97.
- **Power Analyzer:** Voltech, , Model PM3000A, S/N 1527, Cal. Date 01-21-98.
- **Digital Multimeter:** Fluke, , Model 87, S/N 67361177, Cal. Date 4-6-98
- **Microwave Leakage Meter:** Simpson, Model 380M, Cal. Date 9-30-98
- **Temperature Indicator:** Doric, Model 400A, Cal. Date 8-31-98

Tested By:

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International EMC Services

Reviewed By:

Robert Miller
Associate Managing Engineer
International EMC Services

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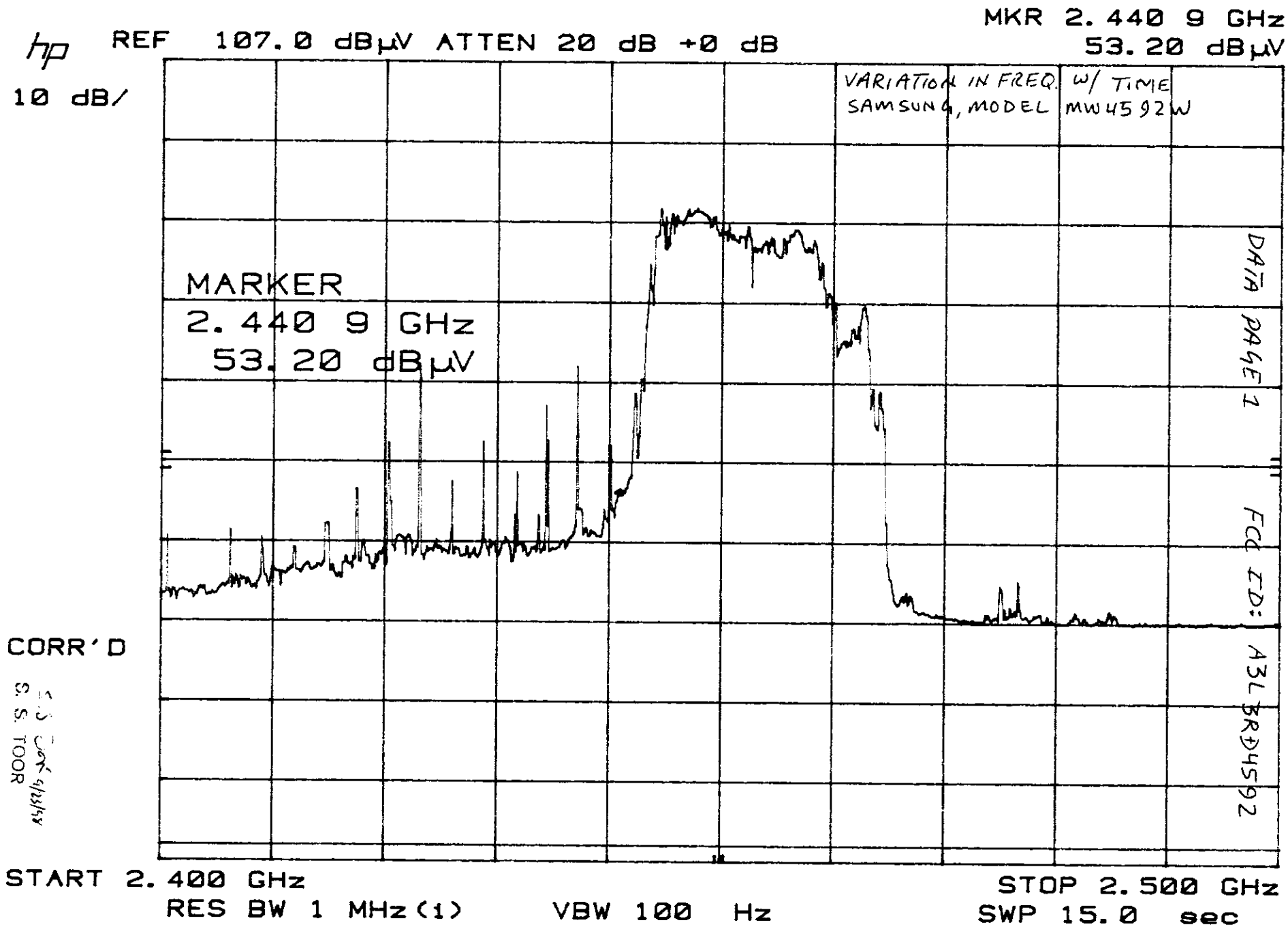
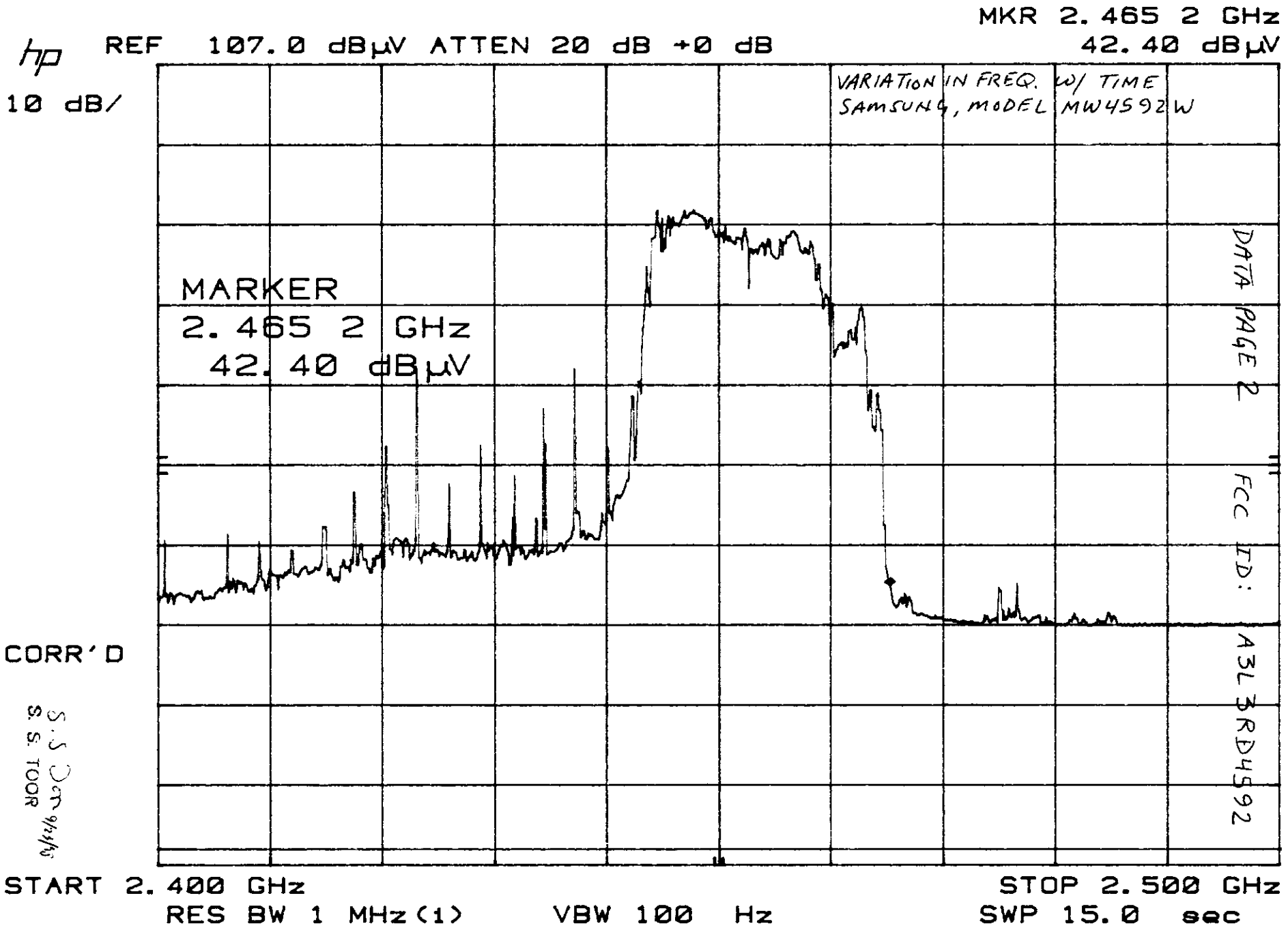
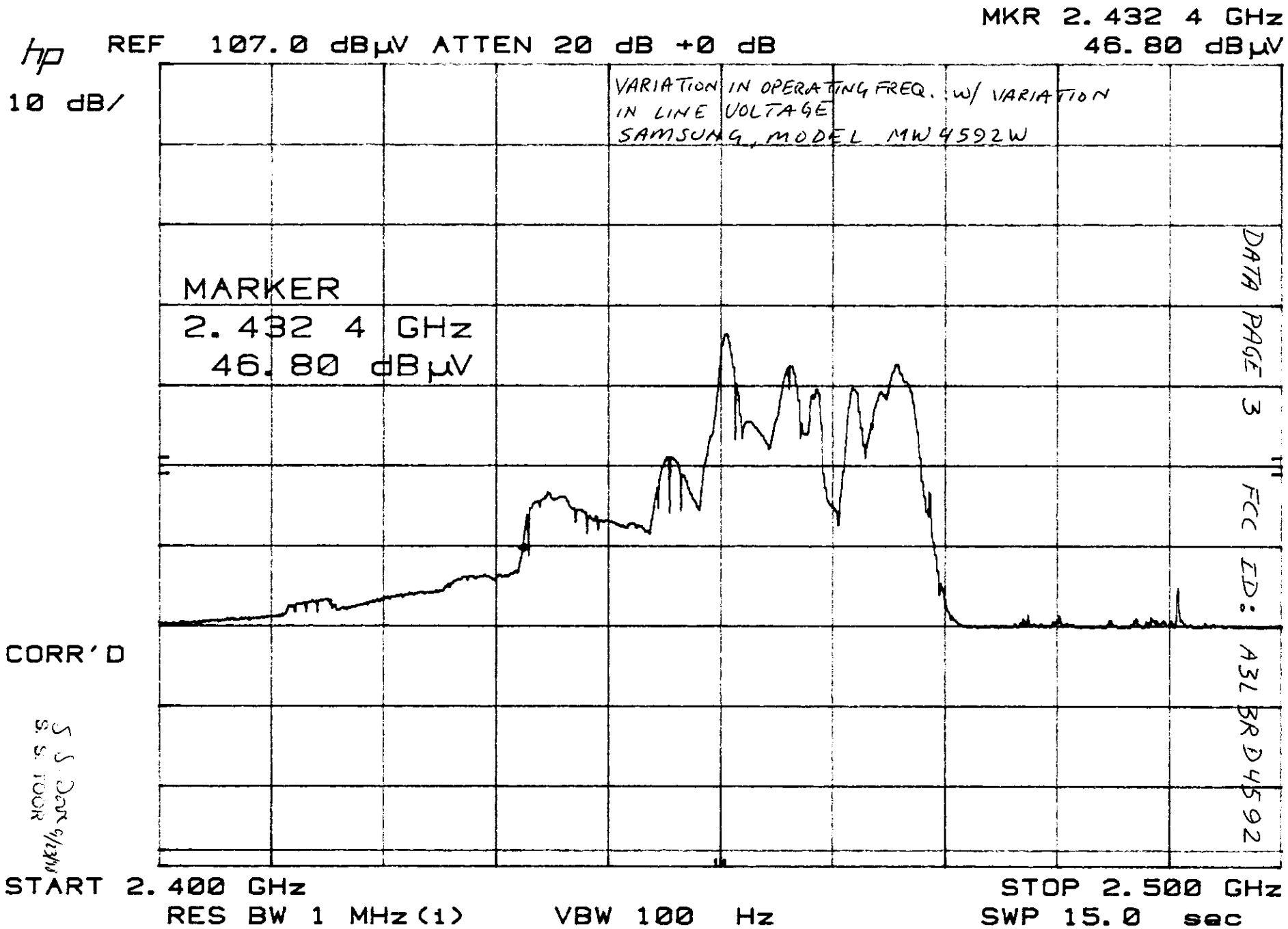
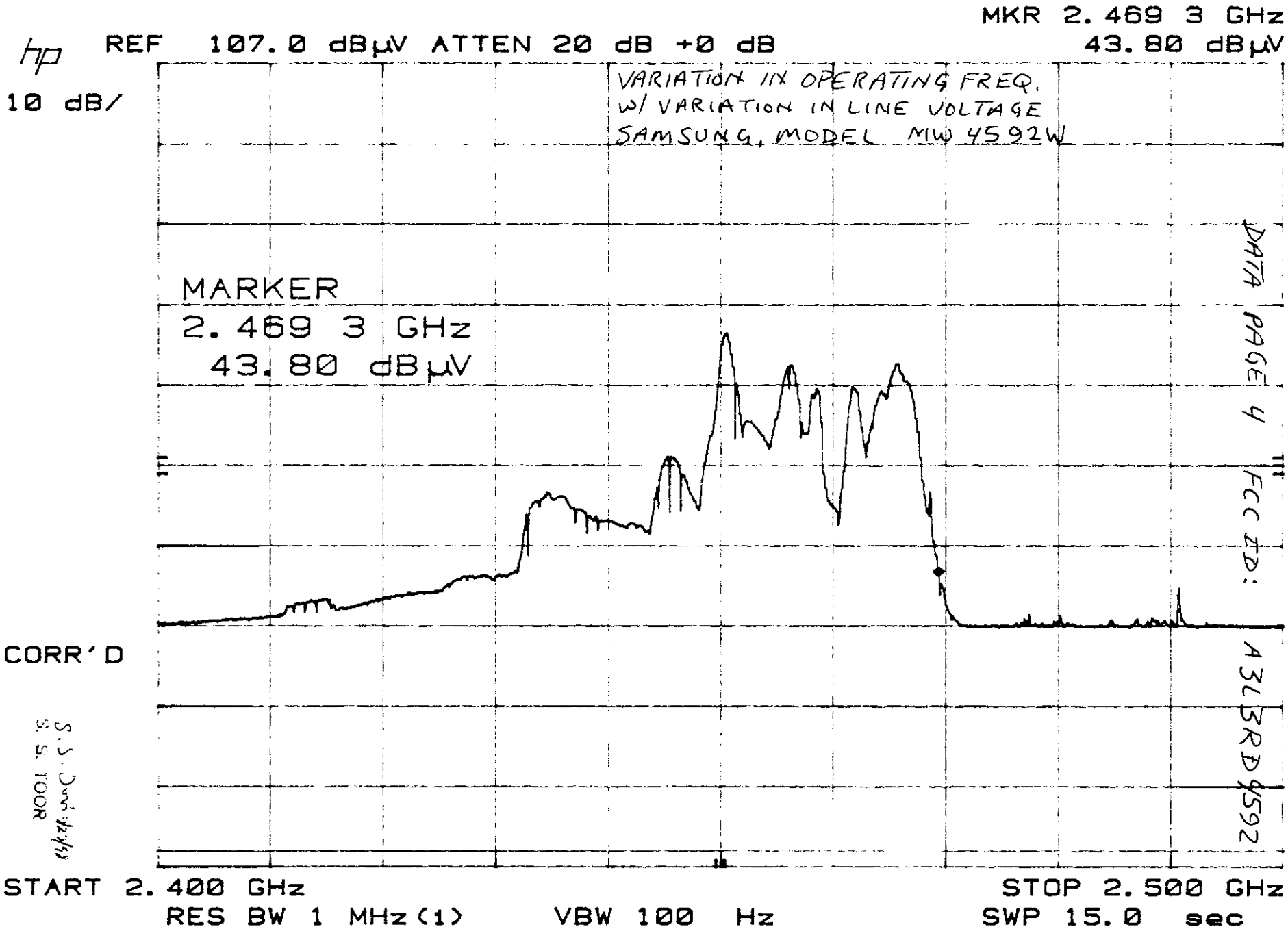

MKR 2.440 9 GHz
53.20 dBµV
hp REF 107.0 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN FREQ. W/ TIME
SAMSUNG, MODEL MW4592W
MARKER
2.440 9 GHz
53.20 dBµV
DATA PAGE 1
FCC ID: A3L BRD4592
CORR'D
START 2.400 GHz
RES BW 1 MHz (i)
VBW 100 Hz
STOP 2.500 GHz
SWP 15.0 sec


MKR 2.465 2 GHz
42.40 dBµV
hp REF 107.0 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN FREQ. W/ TIME
SAMSUNG, MODEL MW4592W
MARKER
2.465 2 GHz
42.40 dBµV
DATA PAGE 2
FCC ID: A3L 3RD4592
CORR'D
S.S. TOOR 9/4/96
START 2.400 GHz
STOP 2.500 GHz
RES BW 1 MHz (1)
VBW 100 Hz
SWP 15.0 sec


MKR 2.432 4 GHz
46.80 dBµV
hp REF 107.0 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN OPERATING FREQ. W/ VARIATION IN LINE VOLTAGE
SAMSUNG, MODEL MW4592W
MARKER
2.432 4 GHz
46.80 dBµV
DATA PAGE 3
FCC ID: A3L BRD4592
CORR'D
S. S. DOOR W/LATCH
START 2.400 GHz
STOP 2.500 GHz
RES BW 1 MHz (1)
VBW 100 Hz
SWP 15.0 sec


MKR 2.469 3 GHz
REF 107.0 dBµV ATTEN 20 dB +0 dB
43.80 dBµV
10 dB/
VARIATION IN OPERATING FREQ.
W/ VARIATION IN LINE VOLTAGE
SAMSUNG, MODEL MW 4592W
MARKER
2.469 3 GHz
43.80 dBµV
DATA
PAGE 4
FCC ID:
A3LBRD4592
CORR'D
S.S. Ouwerkerk
S. S. TOOR
START 2.400 GHz
STOP 2.500 GHz
RES BW 1 MHz (1)
VBW 100 Hz
SWP 15.0 sec

UNDERWRITERS LABORATORIES INC.
ISM SIDEBAND MEASUREMENTS
Data Page 5

Date Tested: 9/23/98

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:	1 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	20.2	4.2	28.7	53.1	1.5	25
2399 H	20.3	4.2	28.7	53.2	1.5	25
2501 V	18.1	4.6	28.9	51.6	1.3	25
2501 H	17.3	4.6	28.9	50.8	1.2	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 6

Date Tested: 9/23/98

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:	1 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						
4897 H	23.0	6.8	34.4	64.2	5.4	25
7362 H	25.0	8.9	36.6	70.5	11.2	25
Load: 700 ml water in right front corner of oven						
4876 H	19.8	6.8	34.3	60.9	3.7	25
7362 H	24.0	8.9	36.6	69.5	10.0	25
Load: 300 ml water in center of oven						
4896 H	23.2	6.8	34.4	64.4	5.5	25
7347 H	28.6	8.9	36.6	74.1	17.0	25
Load: 300 ml water in right front corner of oven						
4888 H	22.6	6.8	34.3	63.7	5.1	25
7347 H	26.1	8.9	36.6	71.6	12.7	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 7

Date Tested: 9/23/98

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:	1 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]
Based on preliminary data, data pages 8 & 9, no measurements were required below 1 GHz						

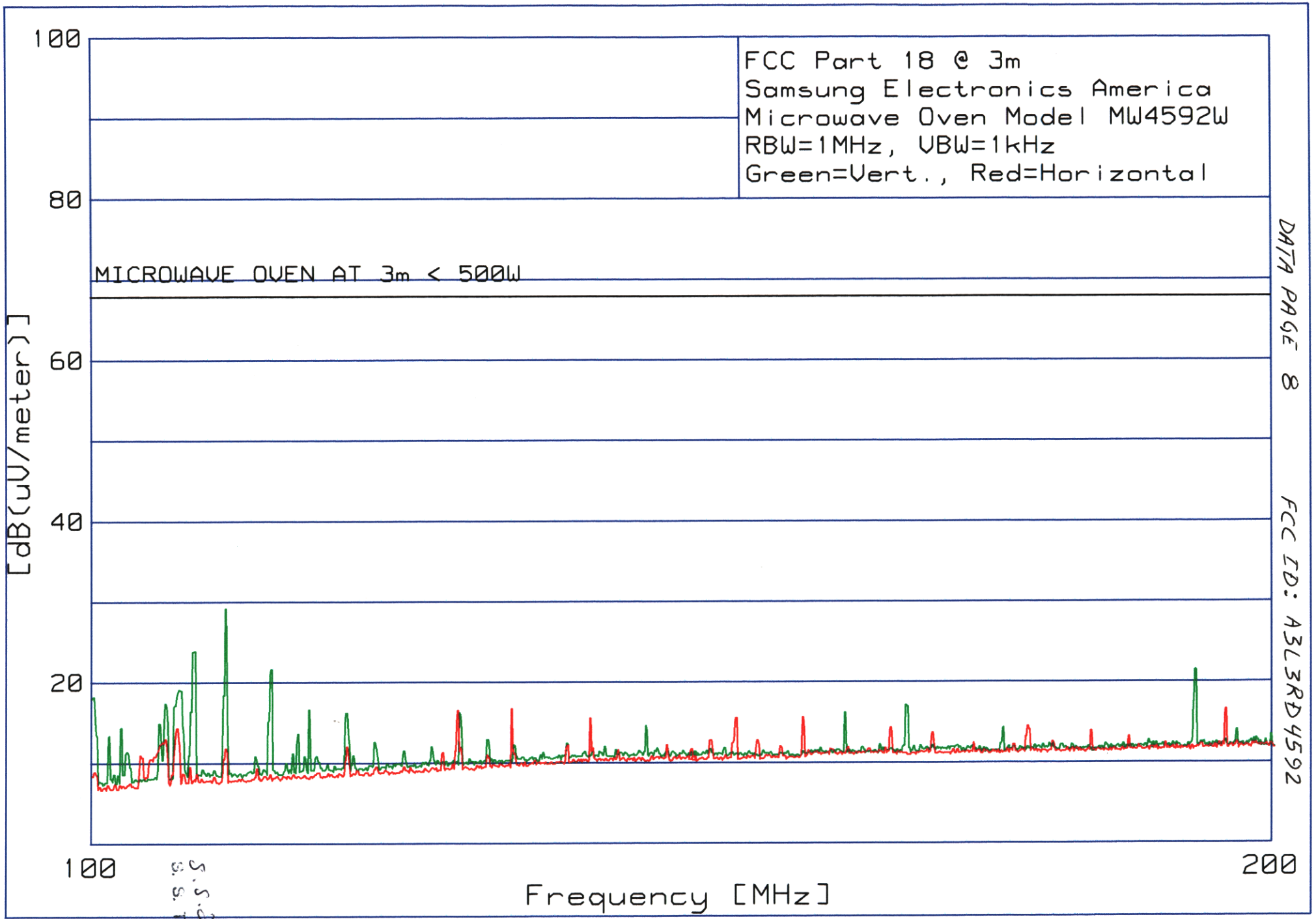
Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
1866 H	20.3	3.9	27.3	51.5	1.3	25
2550 H	17.9	4.4	29.0	51.3	1.2	25

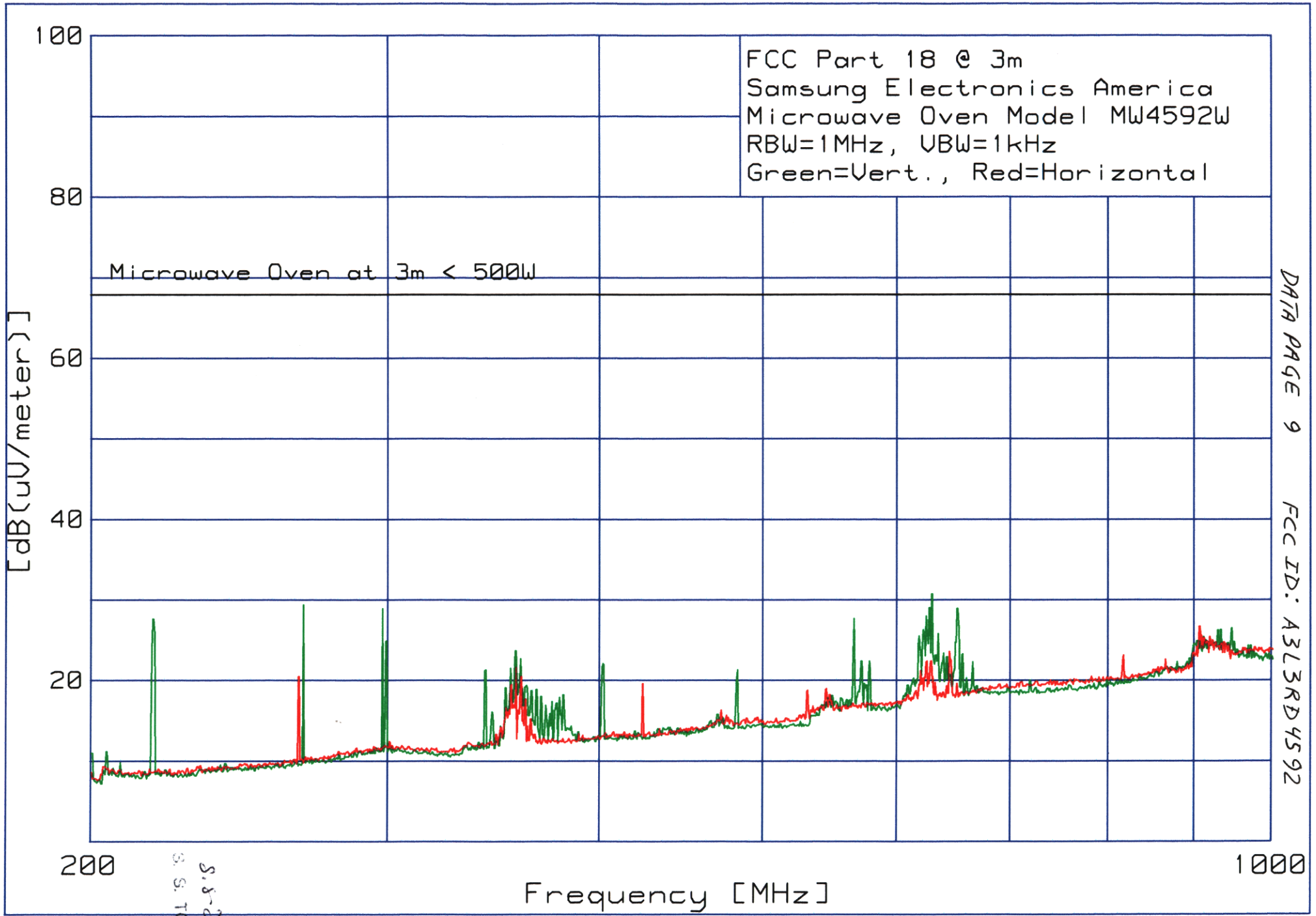
V - indicates vertical antenna polarity H - indicates horizontal antenna polarity.

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]


FCC Part 18 @ 3m
Samsung Electronics America
Microwave Oven Model MW4592W
RBW=1MHz, VBW=1kHz
Green=Vert., Red=Horizontal
MICROWAVE OVEN AT 3m < 500W
100
80
60
40
20
[dB(uV/meter)]
100
200
Frequency [MHz]
DATA PAGE 8
FCC ID: A3L3RD4592
S.S. TOOR


FCC Part 18 @ 3m
Samsung Electronics America
Microwave Oven Model MW4592W
RBW=1MHz, VBW=1kHz
Green=Vert., Red=Horizontal
Microwave Oven at 3m < 500W
100
80
60
40
20
[dB(uV/meter)]
200
1000
Frequency [MHz]
DATA PAGE 9
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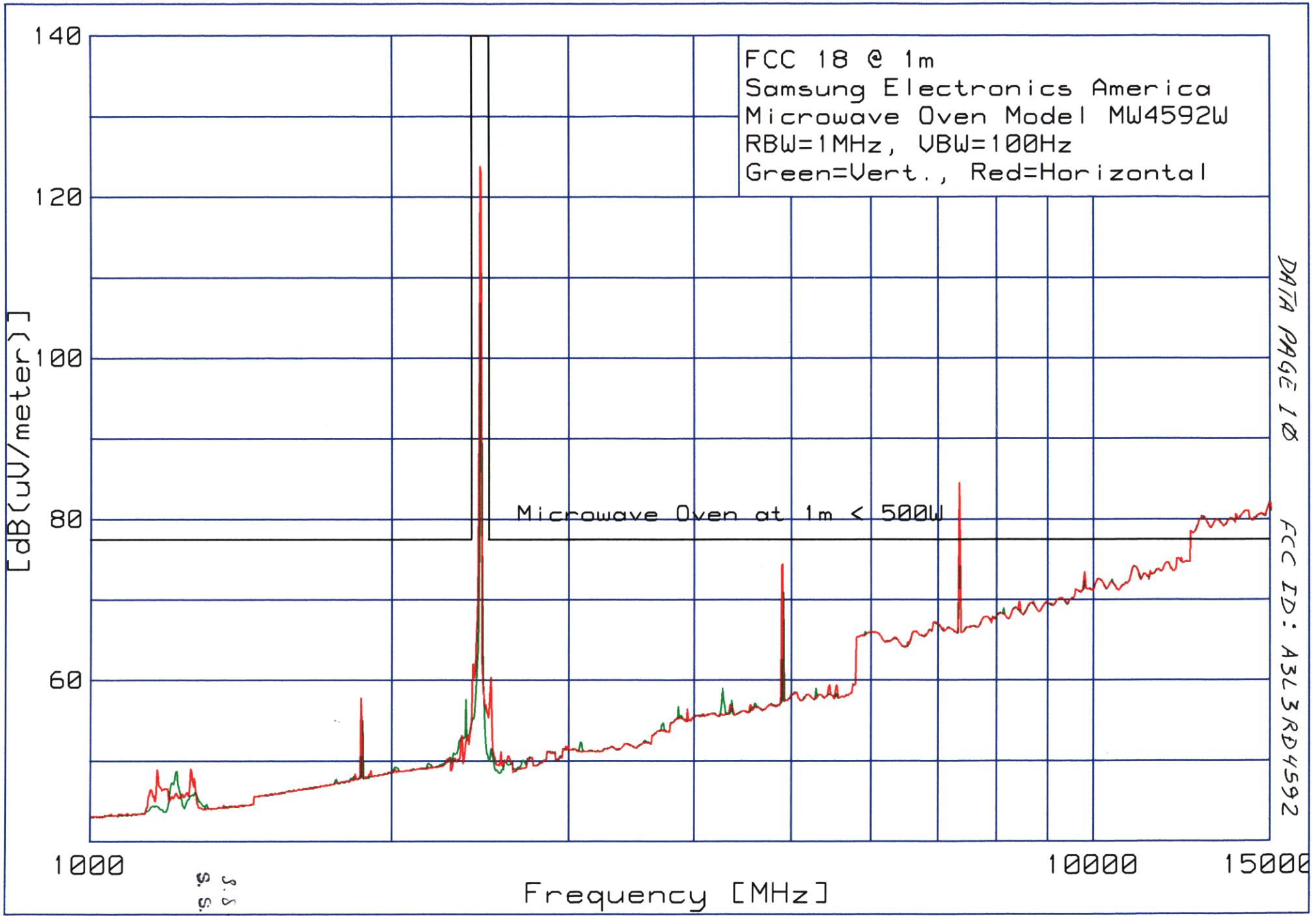
S. S. TOOR



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