1655 Scott Boulevard
Santa Clara California 95050-4169
(408) 985-2400
FAX No. (408) 296-3256
MCI Mail No. 259-3283
Cable ULINC SANTA CLARA, CA

Underwriters Laboratories Inc.®

FCC MEASUREMENT / TECHNICAL TEST REPORT

Samsung Electronics America, Inc.

Microwave Oven Model MW8490W

With Magnetron Samsung, Model OM-75P

FILE: NC2425
PROJECT: 98SC44632
ISSUED: February 8, 1999
FCC ID: A3LMW8490

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 MW8490W
with Magnetron Samsung, Model OM-75P

REPORT PREPARED BY: Underwriters Laboratories, Inc.
1655 Scott Boulevard
Santa Clara, CA 95050-4169 USA
(408) 985-2400

CONTENTS

SECTION		PAGE
1.0 INTRODUCTION		
1.1	Purpose	3
1.2	Description of equipment under test	3
1.3	Referenced standards	3
1.4	Operating Conditions/Test Configuration	3
2.0 RADIO NOISE EMISSION MEASUREMENTS PROCEDURES/RESULTS		
2.1	Radiation Hazard Measurements	4
2.2	Input Power Measurement	4
2.3	Load for Microwave Ovens	5
2.4	RF Output Power Measurement	6
2.5	Operating Frequency Measurements	7
2.5.1	Variation in Operating Frequency with Time	7
2.5.2	Variation in Operating Frequency with Line Voltage	7
2.6	Radiated Emissions	8
3.0 MEASUREMENT EQUIPMENT		9
4.0 TEST DATA		
4.1	OPERATING FREQUENCY MEASUREMENTS	
4.1.1	Variation in Operating Frequency with Time	Data Pages 1,2
4.1.2	Variation in Operating Frequency with Line Voltage	Data Pages 3,4
4.2	ISM Sideband Measurements	Data Page 5
4.4	Harmonic Measurements	Data Page 6
4.5	Out-of-Band Measurements	Data Page 7
4.6	Preliminary Radiated Emissions Measurements	Data Pages 8-10

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

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 countertop 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 10 (100%). The input electrical rating is 120 Vac, 60 Hz, 1.5 kW. The RF Power Output is rated at 1000 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.

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

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.

Input Voltage (Vac)	Input Current (amps)	Measured Input power (watts)	Rated Input Power (watts)
117	14.7	1658	1600

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

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

2.3 LOAD FOR MICROWAVE OVENS

For all measurements the energy developed by the oven was absorbed by a dummy load consisting of a quantity 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 1000 watts.

Load used for output power measurement = 1000 milliliters of water

Load used frequency measurement = 1000 milliliters of water

Load used for harmonic measurement = 700 & 300 milliliters of water

Load used other measurements = 700 milliliters of water

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

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.

Quantity of Water (ml)	Starting Temperature (°C)	Final Temperature (°C)	Elapsed Time (seconds)
1000	21	35	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
27.96 dB (μV/m)
57.5 dB (μV/m) @ 10m
67.96 dB (μV/m) @ 3m
577.5 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.

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

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:

Minimum frequency observed: 2434 MHz
Minimum frequency allowed: 2400 MHz

Maximum frequency observed: 2456 MHz
Maximum frequency allowed: 2500 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.
Minimum frequency observed: 2422 MHz
Minimum frequency allowed: 2400 MHz

Maximum frequency observed: 2460 MHz
Maximum frequency allowed: 2500 MHz

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

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

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 10 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.**

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

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, Last Cal Date 11-24-97.
- **Biconnical Antenna:** Electro-Metrics Inc. Model EM-6912A, S/N 155, Cal. Date new from manufacturer 10/98.
- **Log Periodic Antenna:** Electro-Metrics Inc. Model EM-6950, S/N 1025, Cal. Date new from manufacturer 10/98.
- **Horn Rigid Guide Antenna:** Electro-Metrics Inc. Model EM-6961, S/N 6275, Cal. Date 10-08-98.
- **Power Analyzer:** Voltech, , Model PM3000A, S/N 1527, Cal. Due Date 01-31-99.
- **Digital Multimeter:** Fluke, , Model 87, S/N 67361177, Cal. Date 04-06-98.
- **Microwave Leakage Meter:** Holaday Industries, Model HI-1500, S/N 10012, Cal. Date 09-09-98.
- **Temperature Indicator:** Doric, Model 400A, S/N 38316, Cal. Date 11-10-98.

Tested By:

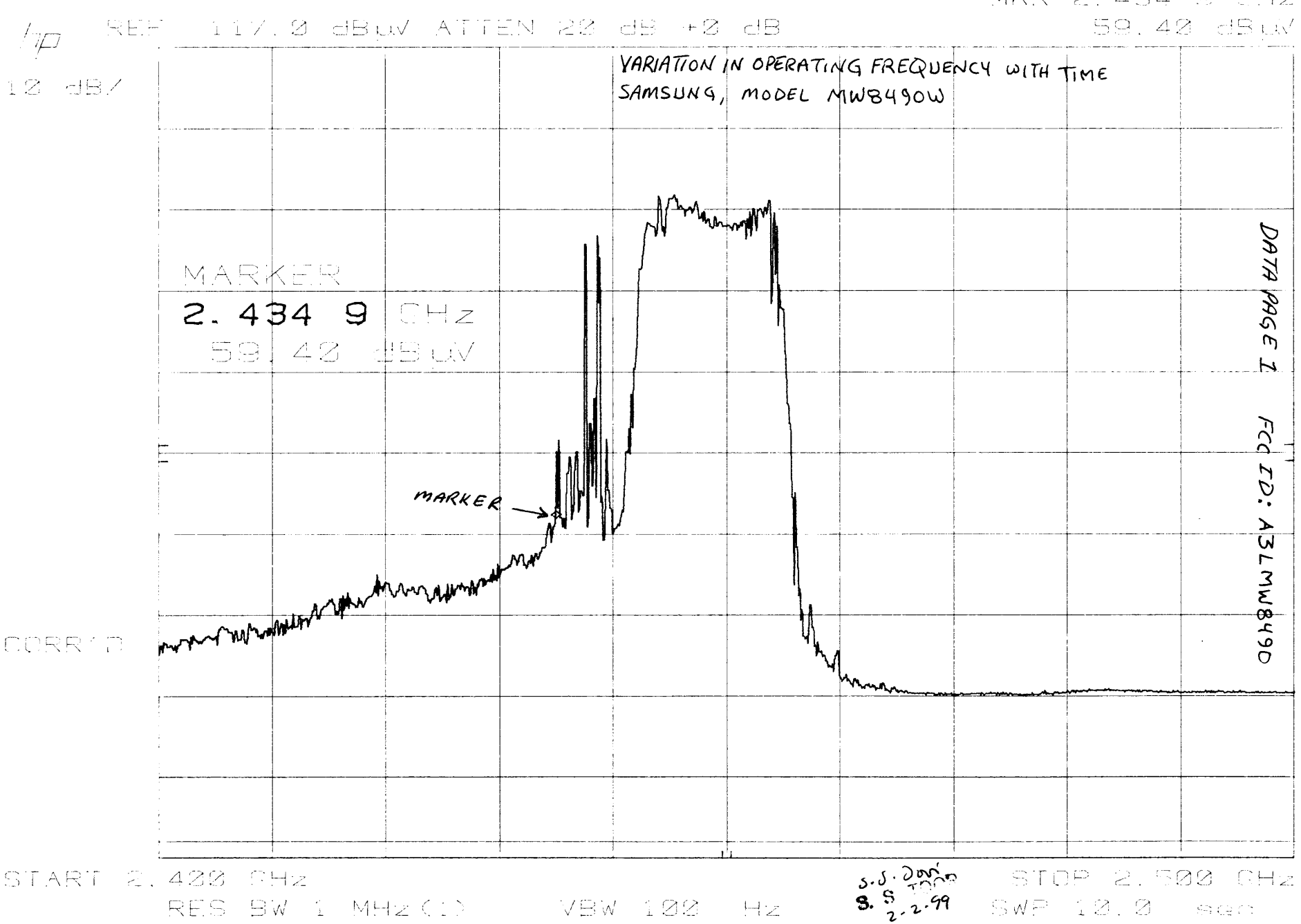
San S. Toor

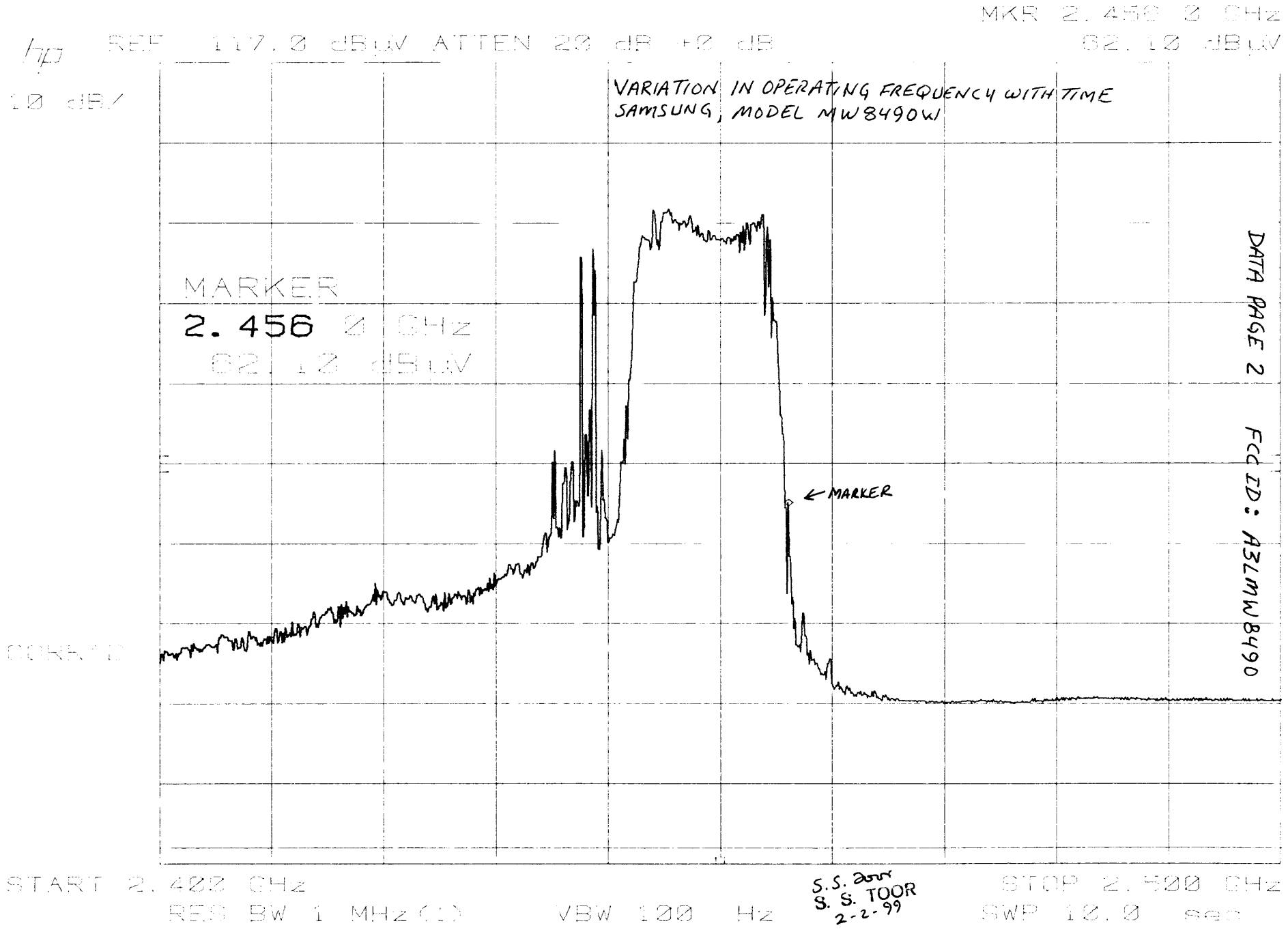
San S. Toor
Senior Project Engineer
International EMC Services

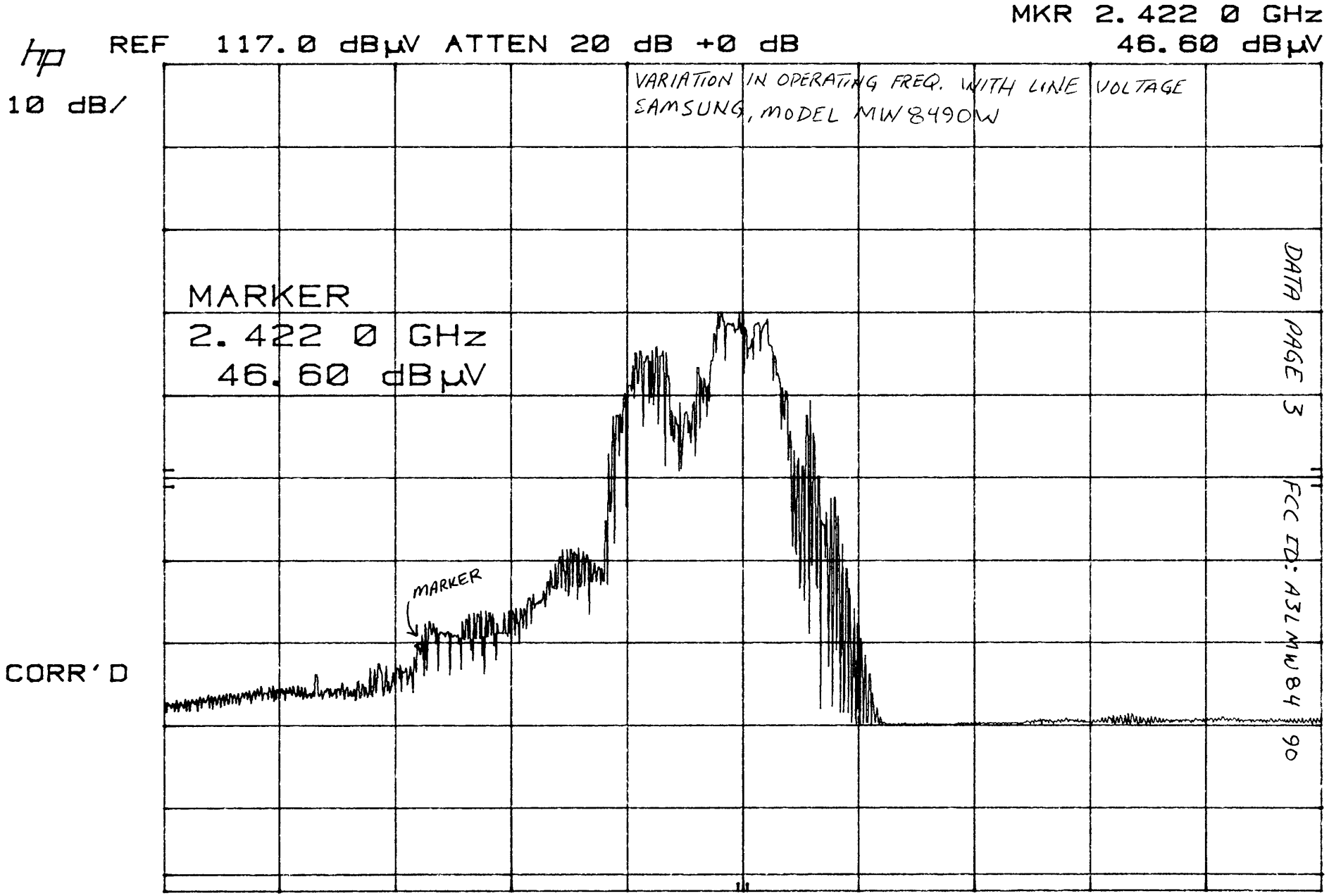
Reviewed By:

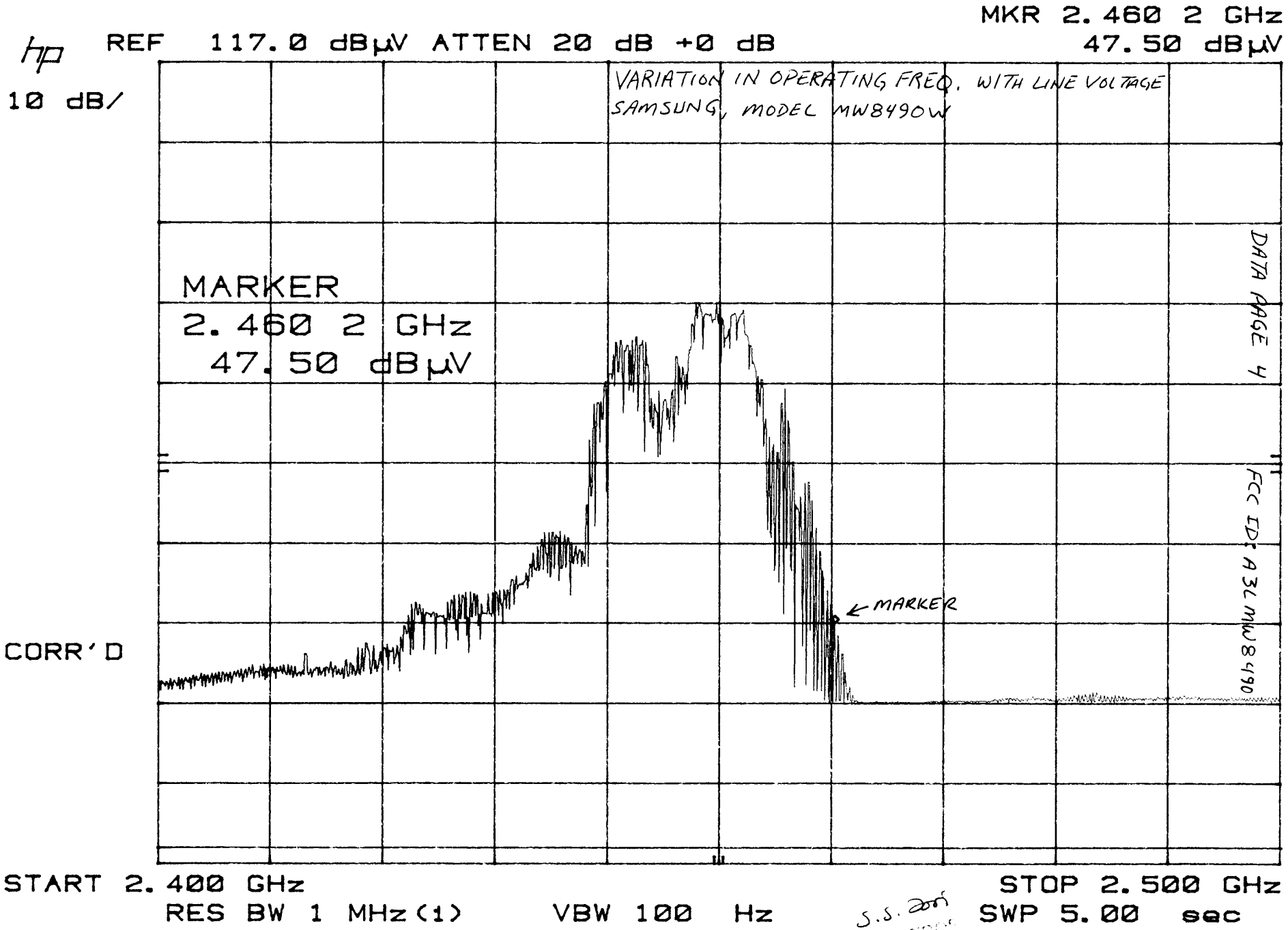
Bob M. Miller
Associate Managing Engineer
International EMC Services

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


MKR 2.434 9 GHz
59.42 dBµV
REF 117.0 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN OPERATING FREQUENCY WITH TIME
SAMSUNG, MODEL MW8490W
MARKER
2.434 9 GHz
59.42 dBµV
MARKER
DATA PAGE 1 FCC ID: A3LMW8490
CORR'D
START 2.400 GHz
RES BW 1 MHz (I)
VBW 100 Hz
STOP 2.500 GHz
SWP 10.0 sec


MKR 2.456 0 GHz
REF 117.0 dBµV ATTEN 20 dB +0 dB
82.10 dBµV
10 dB/
VARIATION IN OPERATING FREQUENCY WITH TIME
SAMSUNG, MODEL MW8490WI
MARKER
2.456 0 GHz
82.10 dBµV
DATA PAGE 2
FCC ID: AZLMW8490
← MARKER
CORR'D
START 2.400 GHz
RES BW 1 MHz (I)
VBW 100 Hz
S.S. Toor
S. S. TOOR
2-2-99
STOP 2.500 GHz
SWP 10.0 sec


MKR 2.422 0 GHz
46.60 dBµV
REF 117.0 dBµV ATTEN 20 dB +0 dB
10 dB/
VARIATION IN OPERATING FREQ. WITH LINE VOLTAGE
SAMSUNG, MODEL MW8490W
MARKER
2.422 0 GHz
46.60 dBµV
MARKER
DATA PAGE 3
FCC ID: A3L MW8490
CORR'D
START 2.400 GHz
RES BW 1 MHz (1)
VBW 100 Hz
STOP 2.500 GHz
SWP 5.00 sec
S. S. Toor
1/27/99



S.S. 2of3
S.S. TOC
1/27/99

UNDERWRITERS LABORATORIES INC.
ISM SIDEBAND MEASUREMENTS
Data Page 5

Date Tested: February 3, 1999

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
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	27.0	4.4	28.3	59.7	3.2	25
2399 H	26.4	4.3	28.1	58.8	2.9	25
2501 V	19.3	4.6	28.4	52.3	1.4	25
2501 H	17.5	4.6	28.2	50.3	1.1	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 6

Date Tested: February 3, 1999

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
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						
4905 H	17.4	7.0	33.0	57.4	2.5	25
7359 H	24.0	8.2	36.4	68.6	9.0	25
Load: 700 ml water in right front corner of oven						
4887 H	18.3	7.0	32.9	58.2	2.7	25
7359 V	22.5	8.2	36.2	66.9	7.4	25
Load: 300 ml water in center of oven						
4898 H	16.3	7.0	33.0	56.3	2.2	25
7318 H	24.6	8.2	36.3	69.1	9.5	25
Load: 300 ml water in right front corner of oven						
4896 H	17.2	7.0	33.0	57.2	2.4	25
7329 V	23.0	8.2	36.2	67.4	7.8	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: February 3, 1999

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, and Log-Periodic Model EM6950
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]
No measurements were required based on preliminary testing, see Data Pages 8, 9.						

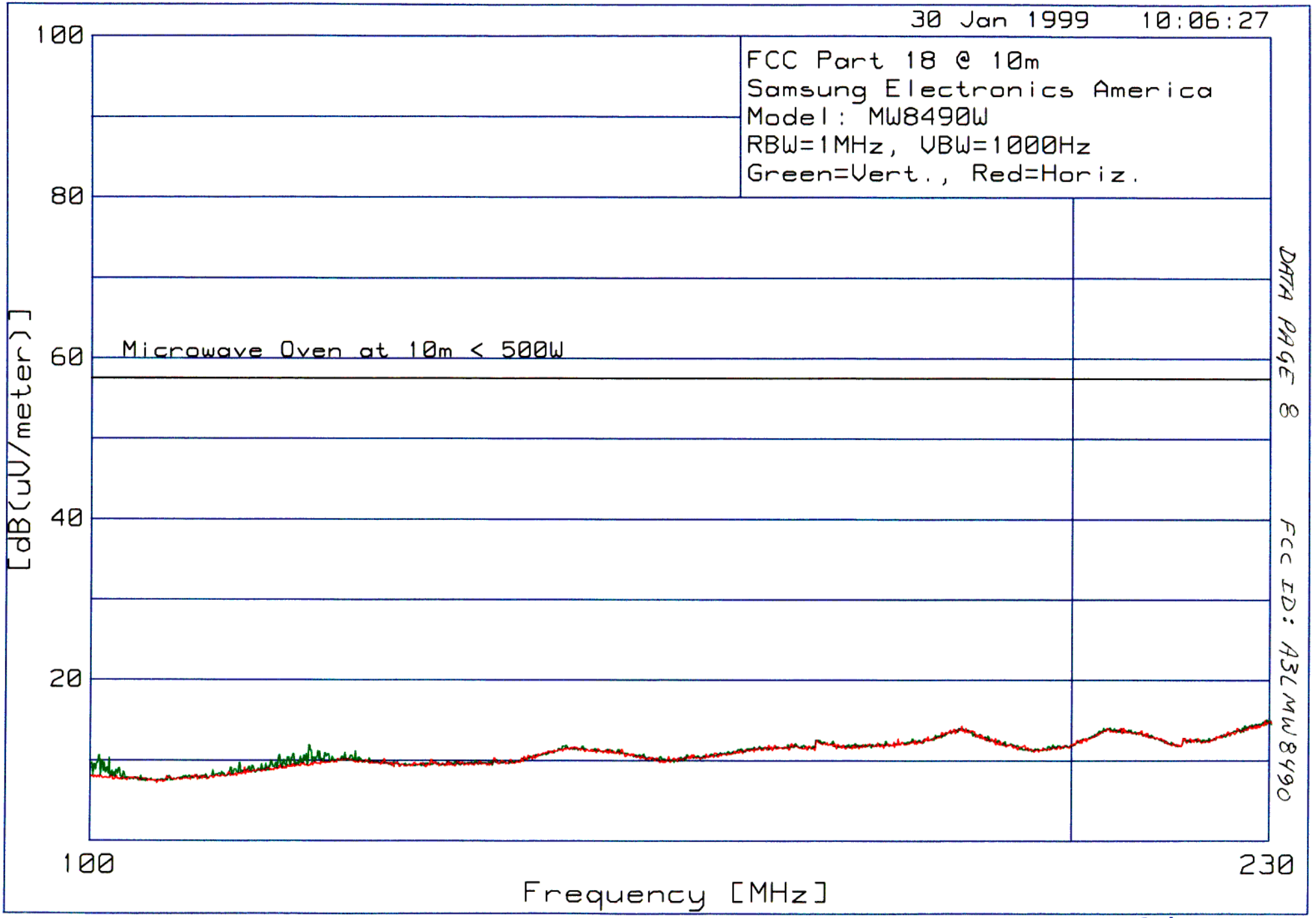
Measured Frequency (MHz)	Meter Reading (dB(μV))	Cable Loss (dB)	Antenna Factor (dB)	1 meter Intensity [dB(μV)/m]	300 meter Intensity [μV/m]	300 meter Limit [μV/m]
1866 H	26.7	4.0	26.9	57.6	2.5	25
9806 H	23.3	10.2	37.5	71.0	10.5	25

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

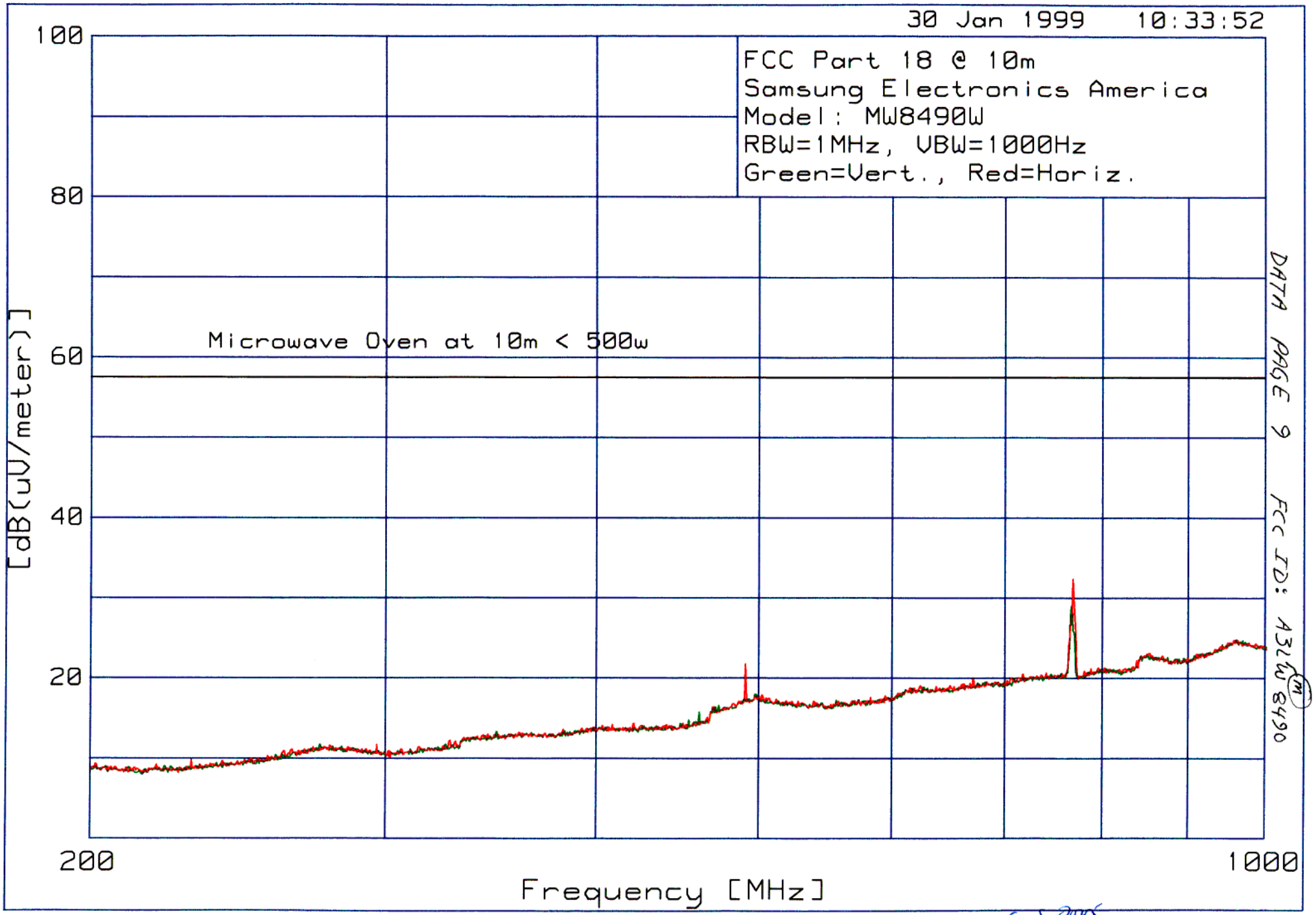
CALCULATIONS - Calculation of the equivalent 300 meter field strength was performed assuming a linear fall-off in the field strength with increased distance from the radiating source.

Field Strength (μV/meter at 300 meters) = K x 10 ^[(SI+AF+CL)/20]

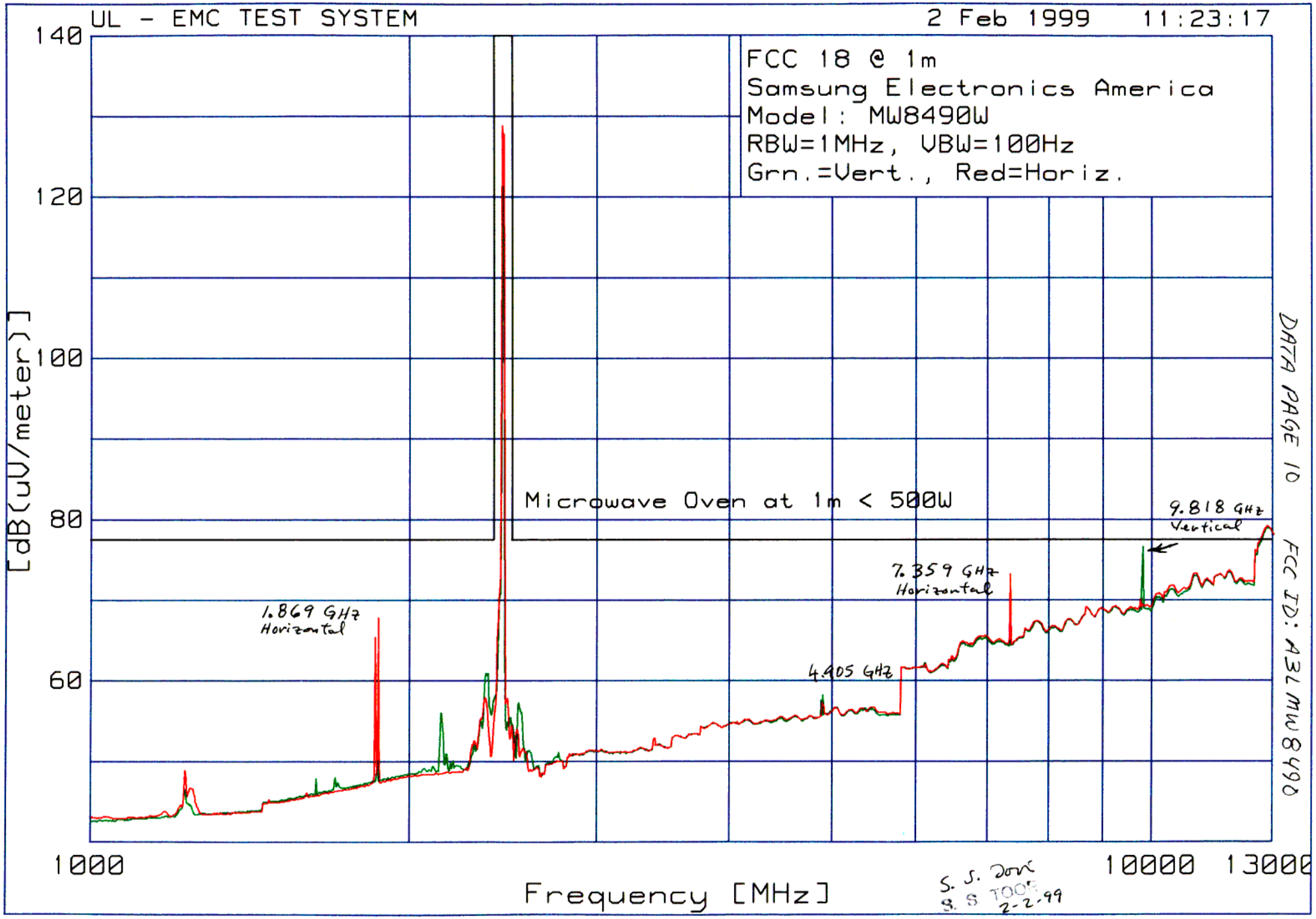
Where: SI is the intensity of the signal in dB(μV)
AF is the antenna factor in dB; CL is the cable loss in dB.
K is the ratio of:[measurement distance/requirement distance]


30 Jan 1999 10:06:27
FCC Part 18 @ 10m
Samsung Electronics America
Model: MW8490W
RBW=1MHz, VBW=1000Hz
Green=Vert., Red=Horiz.
Microwave Oven at 10m < 500W
100
80
60
40
20
[dB(uV/meter)]
100
230
Frequency [MHz]
DATA PAGE 8
FCC ID: A3L MW8490

S. S. TOOR


30 Jan 1999 10:33:52
FCC Part 18 @ 10m
Samsung Electronics America
Model: MW8490W
RBW=1MHz, VBW=1000Hz
Green=Vert., Red=Horiz.
Microwave Oven at 10m < 500w
100
80
60
40
20
[dB(uV/meter)]
200
1000
Frequency [MHz]
DATA PAGE 9 FCC ID: A3LMW8490

S. S. TOOR


UL - EMC TEST SYSTEM
2 Feb 1999 11:23:17
FCC 18 @ 1m
Samsung Electronics America
Model: MW8490W
RBW=1MHz, VBW=100Hz
Grn.=Vert., Red=Horiz.
Microwave Oven at 1m < 500W
1.869 GHz Horizontal
4.905 GHz
7.359 GHz Horizontal
9.818 GHz Vertical
[dB(uV/meter)]
140
120
100
80
60
1000
10000
13000
Frequency [MHz]
DATA PAGE 10
FCC ID: A3L MW8490
S. S. Done
S. S. TOOR 2-2-99