MEASUREMENT REPORT

Scope - Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

Manufacturer:	LG ELECTRONICS INC. - Changwon Plant
Address:	391-2, Ga Eum Jeong-Dong, Changwon-City, Gyeong Nam, 641-110, KOREA
Attention:	Mr. Dae-yong Kang - Senior Engineer Cooking Appliance OBU
Importer:	LG ELECTRONICS U.S.A. INC.
Address:	1000 Sylvan Avenue Englewood Cliff, NJ 07632
U.S.A. Contact:	LG ELECTRONICS INC. (Chicago Office)
Attention:	Mr. K. S. Kim - General Manager

- FCC ID: **BEJV152XD**
- Equipment Type: Microwave Oven
- Magnetron: LG 2M 246 (Sample #1)
  or Toshiba 2M 248E (Sample #2)
- RF Frequency: 2.450 GHz
- RF Power Output: 1000 Watt
  or 1050 Watt
- Trade Name(s): ***GoldStar®***
- Model: ***MV-1520M***
- Power Cord: Unshielded
- Rule Part(s): FCC Part 18 - ISM Consumer Device
- Test Procedure: MP-5
- Dates of Tests: April 20-21, 1998
  Place of Tests: PCTEST Lab, Columbia, MD U.S.A.
  Test Report S/N: 18.980417282.BEJ

NVLAP
Lab Code 100431-0

Introduction

The measurement procedure described in MP-5 entitled "FCC Methods of Measurements of Radio Noise Emissions from Industrial, Scientific, and Medical Equipment" was used in determining frequency measurement, power output measurement, and field strength measurement emanating from **LG Electronics Inc. (GoldStar Model: *MV-1520M*) Microwave Oven FCC ID: BEJV152XD**.

These measurement tests were conducted at *PCTEST Engineering Laboratory* facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39°11'15" N latitude and 76°49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on October 19, 1992.

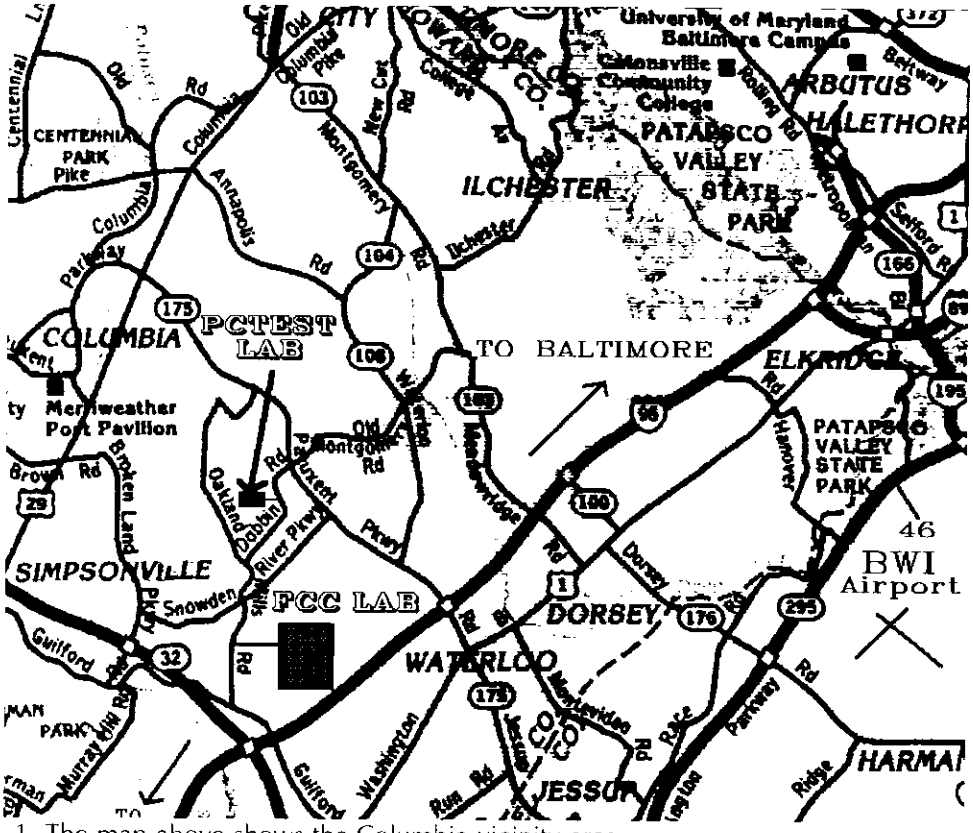


Fig. 1. The map above shows the Columbia vicinity area.
The map also shows PCTest Lab, FCC Lab and BWI airport. (Scale 1"=2miles)

Test Data (#1: LG Magnetron Model: 2M 246)

A. Input Power

The input power was measured using a RMS wattmeter. A 275ml. water load in a polypropylene beaker is placed in the center of the oven. The 275ml. of water was chosen for its compatibility with UL procedure to determine input ratings. The oven was operated at full output power for 6 minutes. The reading was taken after 6 minutes at full power.

Source	**Voltage** (VAC)	**Current** (Amps)	**Power Consumption** (Watts)	**Manufacturers Rating** (Amps)
MWO	108.9	13.96	1457	13.0
MWO + Lamp + Fan	108.2	13.78	1468	14.0

B. Power Output

The calorimetric method was used in determining the maximum output power. The test method described in MP-5 and IEC Publication 705/1988. A 1000ml. of water in a beaker was placed in the center of the oven. The oven was operated at full power.

$$P(W) = \frac{4.187 \times Q \times \Delta T}{t}$$

[ΔT = Temperature Rise in °C]
[Q = Quantity of Water in ml]
[t = Operation Time in sec.]

Quantity of Water Q = 1000ml. = 1 liter
Starting Temp. = 20°C
Time = 120 sec.
Final Temp. = 45.8 °C

Power (W) = $\frac{4.187 \times 1000 \times 25.8}{120}$

Power (W) = 900.2 Watts

Test Data (#2: Toshiba Magnetron Model: 2M 248E)

A. Input Power

The input power was measured using a RMS wattmeter. A 275ml. water load in a polypropylene beaker is placed in the center of the oven. The 275ml. of water was chosen for its compatibility with UL procedure to determine input ratings. The oven was operated at full output power for 6 minutes. The reading was taken after 6 minutes at full power.

Source	Voltage (VAC)	Current (Amps)	Power Consumption (Watts)	Manufacturers Rating (Amps)
MWO only	108.5	13.52	1426	13.0
MWO + Lamp + Fan	108.3	13.80	1465	14.0

B. Power Output

The calorimetric method was used in determining the maximum output power. The test method described in MP-5 and IEC Publication 705/1988. A 1000ml. of water in a beaker was placed in the center of the oven. The oven was operated at full power.

$$P(W) = \frac{4.187 \times Q \times \Delta T}{t}$$

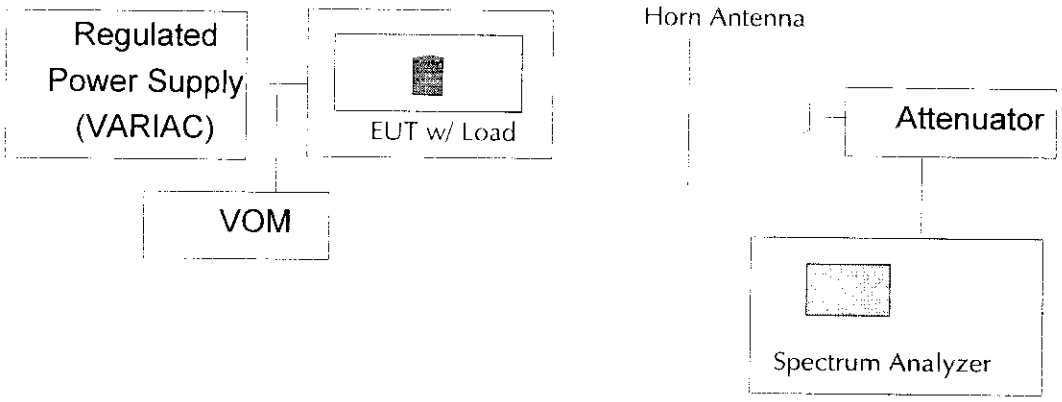
[ΔT = Temperature Rise in °C]
[Q = Quantity of Water in ml]
[t = Operation Time in sec.]

Quantity of Water Q = 1000ml. = 1 liter
Starting Temp. = 20°C
Time = 120 sec.
Final Temp. = 46.1 °C

Power (W) = $\frac{4.187 \times 1000 \times 26.1}{120}$

Power (W) = 910.7 Watts

C. Frequency Measurements (#1: LG 2M 246 Magnetron)



Sample #1

(1) Frequency vs. Load variation test

Initial Load 1000ml Final Load 200ml
Fundamental Freq. 2.450 GHz
Limit 2.4GHz<2.5GHz

Minimum Frequency Observed: 2.426 GHz
Maximum Frequency Observed: 2.459 GHz

CONCLUSION: **PASS**

(2) Frequency vs. Line Voltage variation test

Variation of line voltage from 80% (96Volts) to 125% (150Volts)
Load 1000ml
Fundamental Freq. 2.450 GHz
Limit 2.4GHz<2.5GHz

Minimum Frequency Observed: 2.417 GHz
Maximum Frequency Observed: 2.455 GHz

CONCLUSION: **PASS**

C. Frequency Measurements (#2: Toshiba 2M 248E Magnetron)

Sample #2

(1) Frequency vs. Load variation test

Initial Load 1000ml Final Load 200ml
Fundamental Freq. 2.450 GHz
Limit 2.4GHz<2.5GHz

Minimum Frequency Observed: 2.415 GHz
Maximum Frequency Observed: 2.460 GHz

CONCLUSION: **PASS**

(2) Frequency vs. Line Voltage variation test

Variation of line voltage from 80% (96Volts) to 125% (150Volts)
Load 1000ml
Fundamental Freq. 2.450 GHz
Limit 2.4GHz<2.5GHz

Minimum Frequency Observed: 2.409 GHz
Maximum Frequency Observed: 2.461 GHz

CONCLUSION: **PASS**

D. Power Density Safety Check

The power density was check to ensure that the power is not greater than 1.0mW/cm^2 at any location of the oven. The 1.0mW/cm^2 is in accordance with CDRH and UL 923 specifications. (For Sample #1 & Sample #2)

A microwave survey meter was placed on all sides, bottom, and top of the oven.
No power greater than 0.10mW/cm^2 was observed and did not exceed the specified limits.

CONCLUSION: **PASS**

Test Data (#1: LG Magnetron Model: 2M 246)

E. Radiated Emissions

Preliminary measurements were made inside an anechoic chamber at 1 meter to determine the emission characteristics of the EUT. The EUT is configured and operated in a manner which produces the maximum emission in a typical configuration. Final measurements were made outdoors at our 3-meter test site.

FREQ. (GHz)	AFCL (dB)	Load (ml)	Load Location	Meter Reading (dBμV)	F/S @ 3m. (dBμV)	F/S @ 3m. (μV/m)	FCC Limit @ 300m (μV/m)	F/S @ 300m (μV/m)
2.208	38.2	700	Rt. Front	29.8	68.0	2511.9	33.5	25.1
2.601	39.0	700	Rt. Front	26.4	65.4	1862.1	33.5	18.6
4.803	47.8	300	Center	15.4	63.2	1445.4	33.5	14.5
4.838	47.8	300	Center	18.7	66.5	2113.5	33.5	21.1
4.962	47.8	700	Center	17.1	64.9	1757.9	33.5	17.6
4.989	47.8	700	Center	20.0	67.8	2454.7	33.5	24.6
7.321	53.6	300	Rt. Front	11.7	65.3	1840.8	33.5	18.4
7.340	53.6	300	Center	14.8	68.4	2630.3	33.5	26.3
7.342	53.6	700	Rt. Front	15.1	68.7	2722.7	33.5	27.2
7.350	53.6	700	Center	15.7	69.3	2917.4	33.5	29.2
9.881	58.4	700	Rt. Front	4.9	63.3	1462.2	33.5	14.6

NOTES:

1. ***Measurements using Average detector (RBW=1MHz VBW=10Hz)***
2. ***AFCL = Antenna Factor and Cable Loss***
3. ***F/S = Field Strength***
4. ***Limit per §18.305 = $25\sqrt{Power}/500$***

Test Data (#2: Toshiba Magnetron Model: 2M 248E)

E. Radiated Emissions

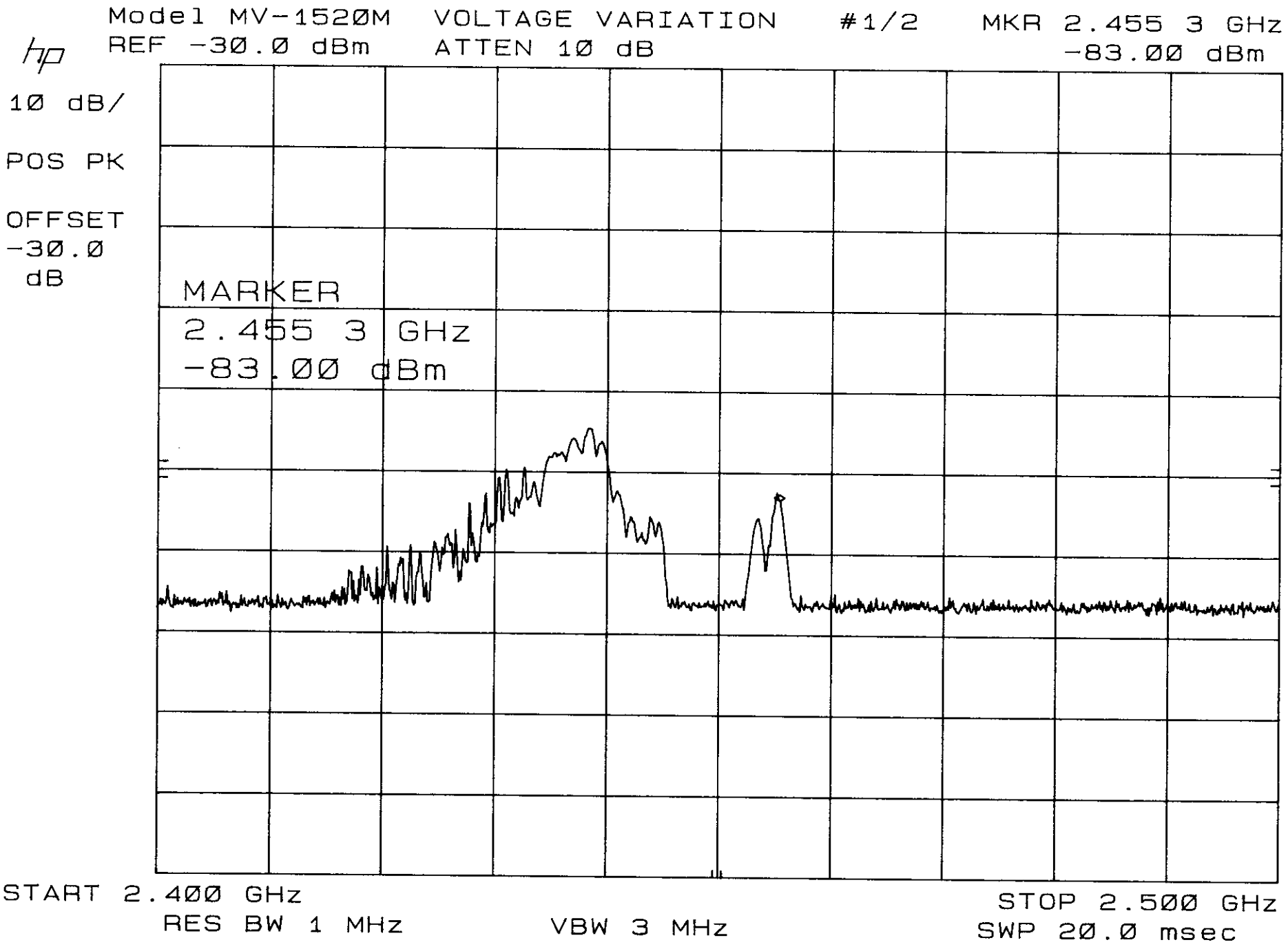
Preliminary measurements were made inside an anechoic chamber at 1 meter to determine the emission characteristics of the EUT. The EUT is configured and operated in a manner which produces the maximum emission in a typical configuration. Final measurements were made outdoors at our 3-meter test site.

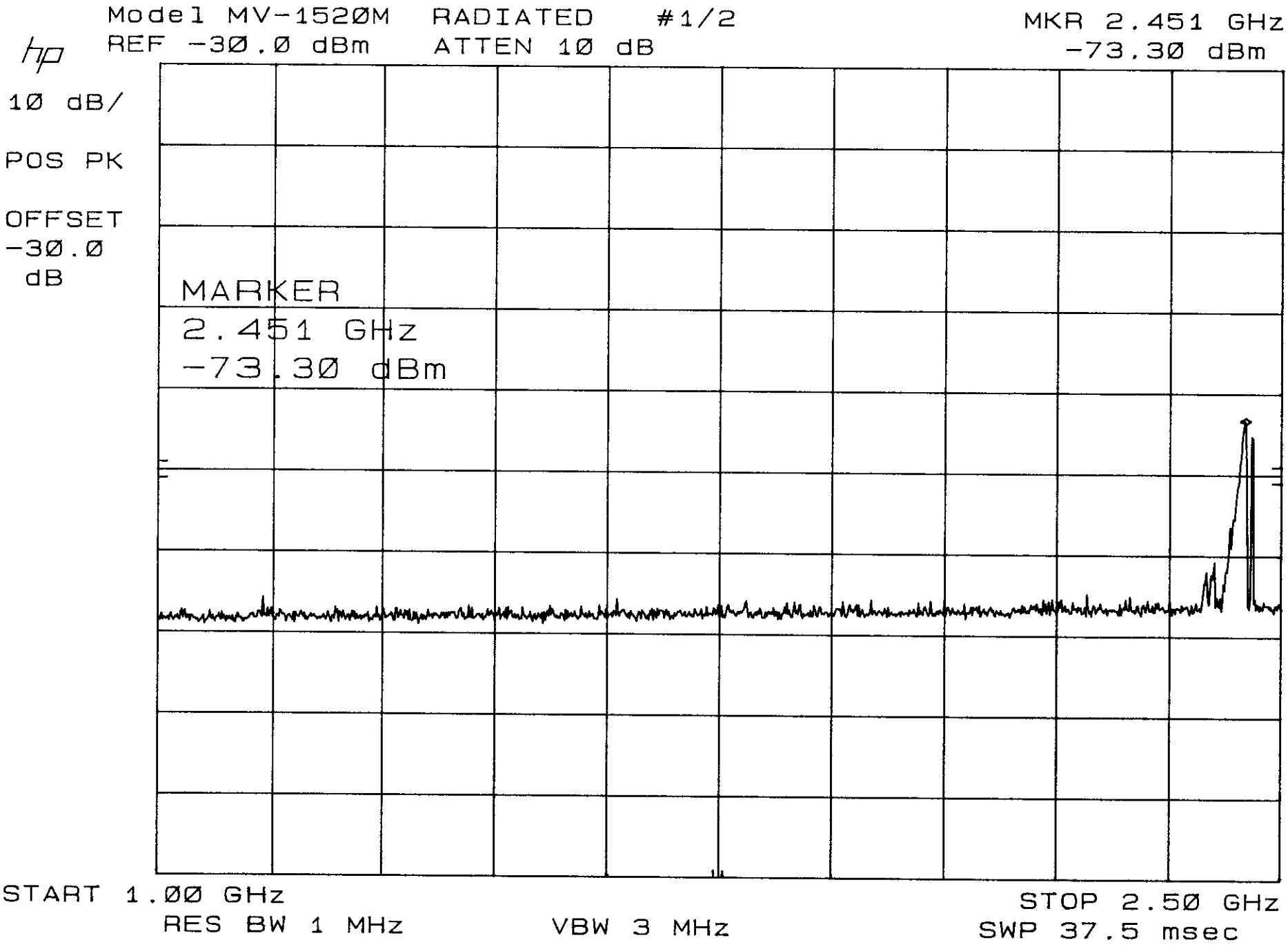
FREQ. (GHz)	AFCL (dB)	Load (ml)	Load Location	Meter Reading (dBμV)	F/S @ 3m. (dBμV)	F/S @ 3m. (μV/m)	FCC Limit @ 300m (μV/m)	F/S @ 300m (μV/m)
2.218	38.2	700	Rt. Front	24.3	62.5	1333.5	33.7	13.3
2.615	39.0	700	Rt. Front	22.8	61.8	1230.3	33.7	12.3
4.840	47.8	300	Center	12.3	60.1	1011.6	33.7	10.1
4.843	47.8	300	Center	12.6	60.4	1047.1	33.7	10.5
4.890	47.8	700	Center	12.0	59.8	977.2	33.7	9.8
4.954	47.8	700	Center	13.5	61.3	1161.5	33.7	11.6
7.333	53.6	300	Rt. Front	8.8	62.4	1318.3	33.7	13.2
7.358	53.6	300	Center	9.9	63.5	1496.2	33.7	15.0
7.381	53.6	700	Rt. Front	8.7	62.3	1303.2	33.7	13.0
7.375	53.6	700	Center	8.2	61.8	1230.3	33.7	12.3
9.790	58.4	700	Rt. Front	0.3	58.7	861.0	33.7	8.6

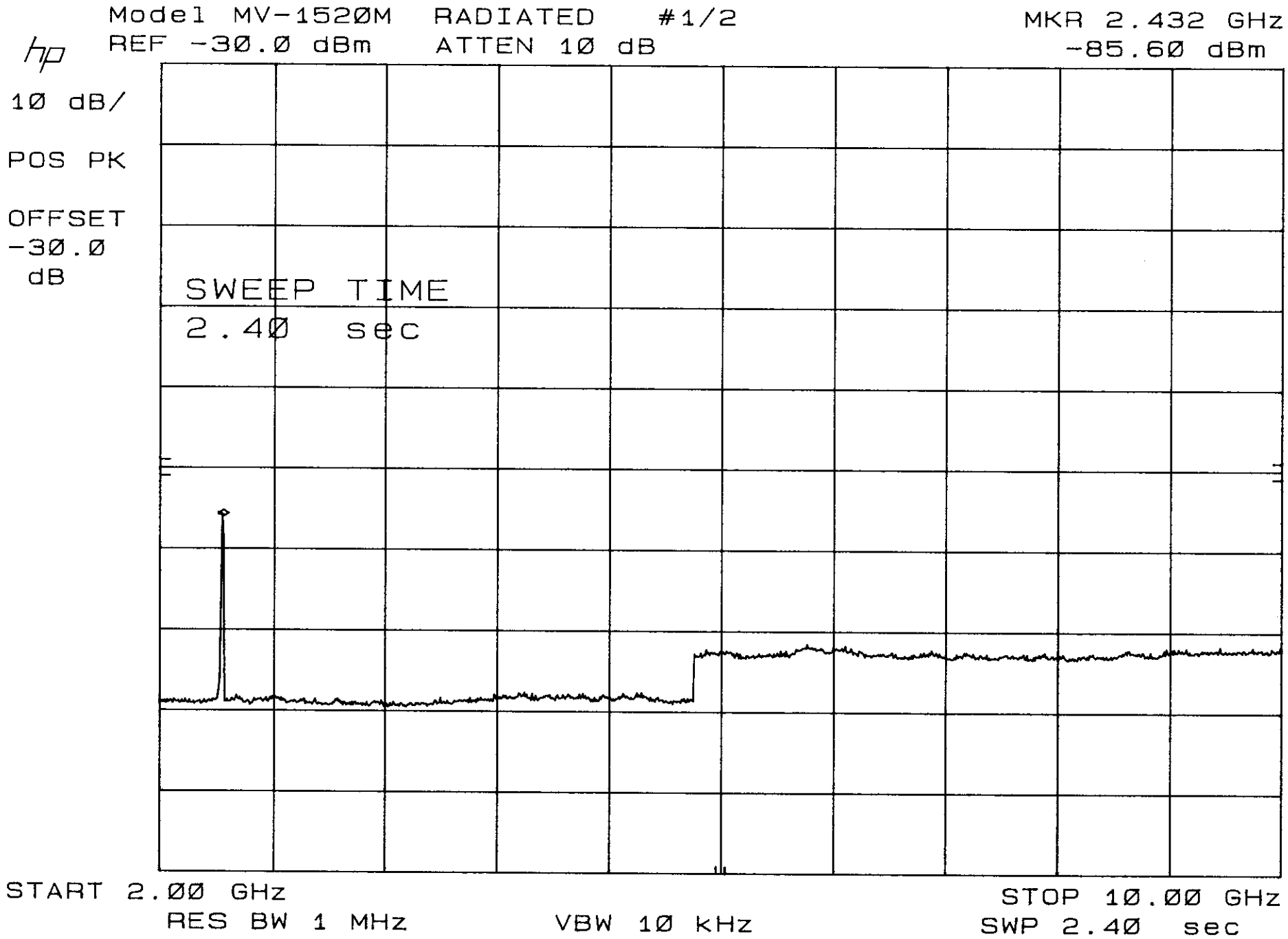
NOTES:

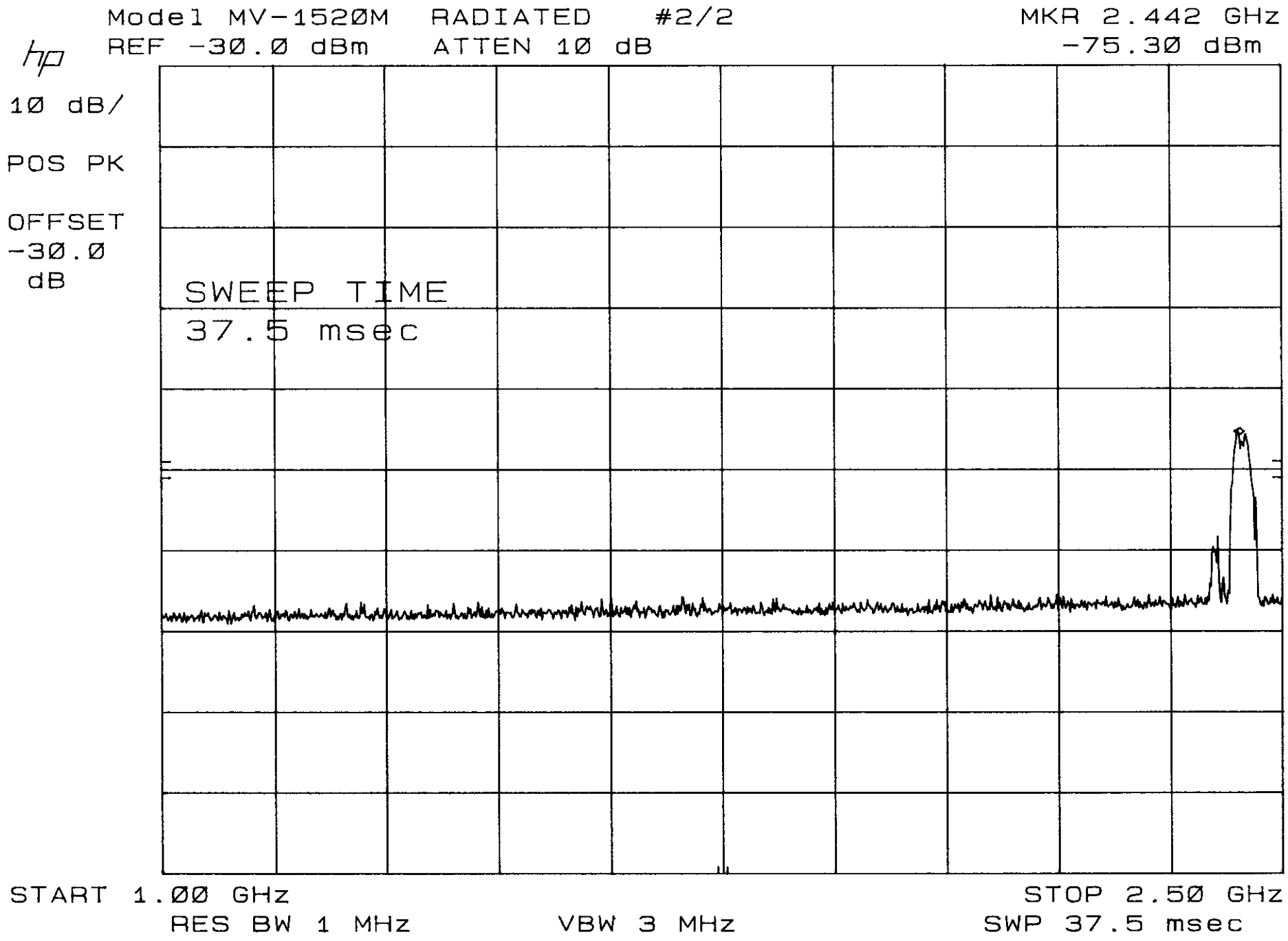
1. ***Measurements using Average detector (RBW=1MHz VBW=10Hz)***
2. ***AFCL = Antenna Factor and Cable Loss***
3. ***F/S = Field Strength***
4. ***Limit per §18.305 = $25\sqrt{Power}/500$***

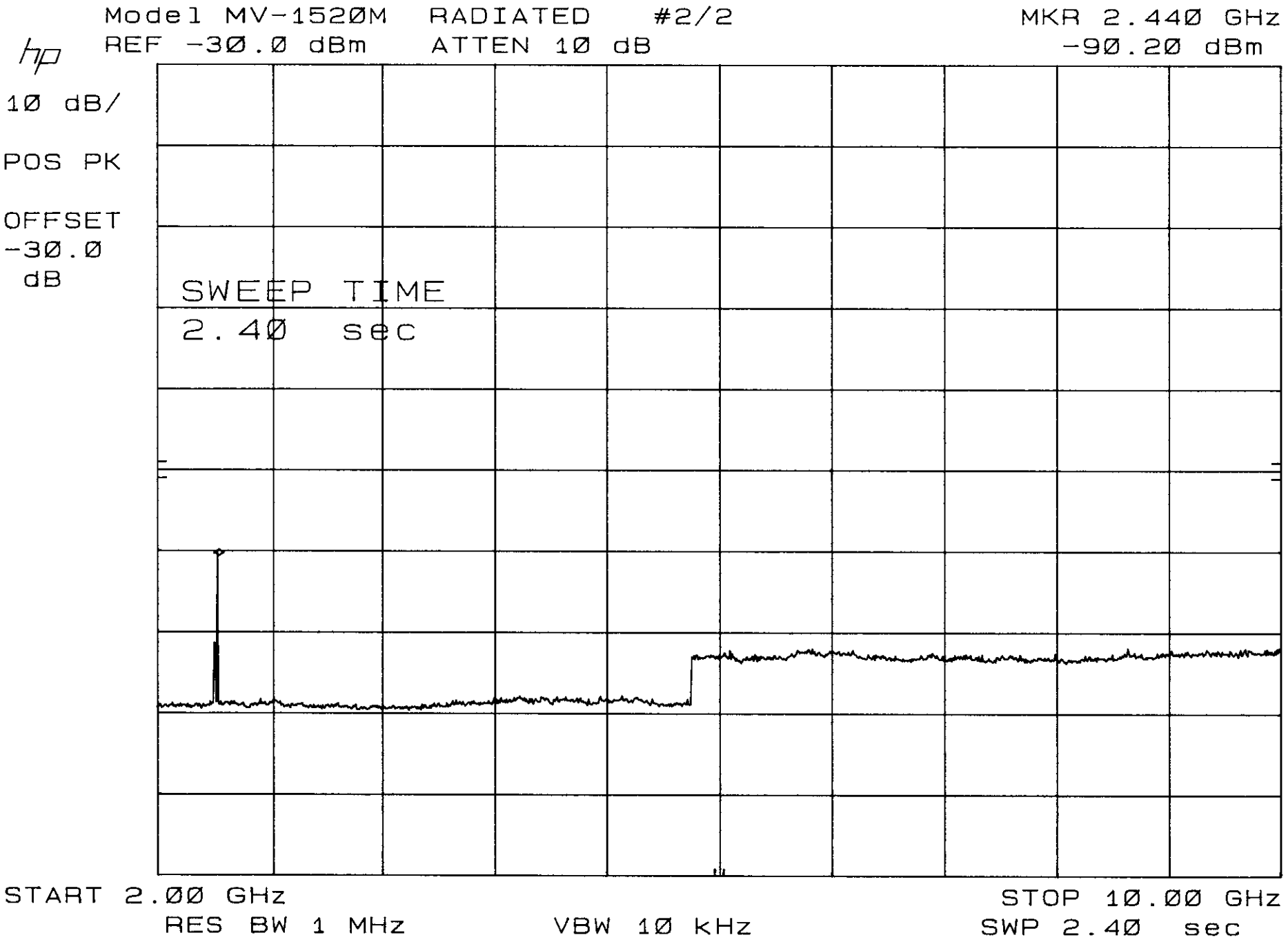
Plot(s) of Emission

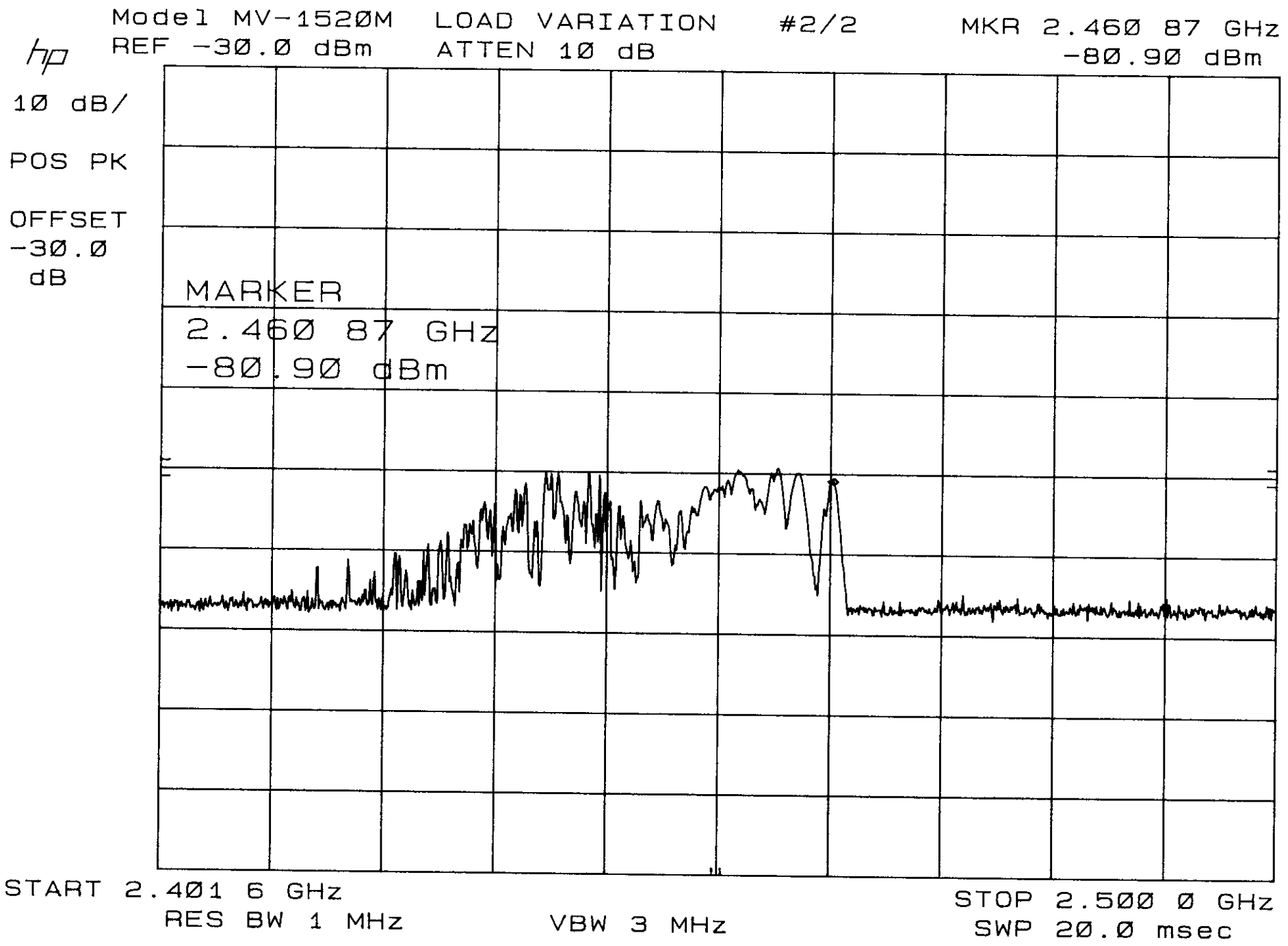

Model MV-1520M VOLTAGE VARIATION #1/2 MKR 2.455 3 GHz
REF -30.0 dBm ATTEN 10 dB -83.00 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
MARKER
2.455 3 GHz
-83.00 dBm
START 2.400 GHz
RES BW 1 MHz
VBW 3 MHz
STOP 2.500 GHz
SWP 20.0 msec


Model MV-1520M RADIATED #1/2
REF -30.0 dBm ATTEN 10 dB
MKR 2.451 GHz
-73.30 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
MARKER
2.451 GHz
-73.30 dBm
START 1.00 GHz
RES BW 1 MHz
VBW 3 MHz
STOP 2.50 GHz
SWP 37.5 msec


Model MV-1520M RADIATED #1/2
REF -30.0 dBm ATTEN 10 dB
MKR 2.432 GHz
-85.60 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
SWEEP TIME
2.40 sec
START 2.00 GHz
RES BW 1 MHz
VBW 10 kHz
STOP 10.00 GHz
SWP 2.40 sec


Model MV-1520M RADIATED #2/2
MKR 2.442 GHz
REF -30.0 dBm ATTEN 10 dB
-75.30 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
SWEEP TIME
37.5 msec
START 1.00 GHz
STOP 2.50 GHz
RES BW 1 MHz
VBW 3 MHz
SWP 37.5 msec


Model MV-1520M RADIATED #2/2
MKR 2.440 GHz
REF -30.0 dBm ATTEN 10 dB
-90.20 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
SWEEP TIME
2.40 sec
START 2.00 GHz
STOP 10.00 GHz
RES BW 1 MHz
VBW 10 kHz
SWP 2.40 sec


Model MV-1520M LOAD VARIATION #2/2
REF -30.0 dBm ATTEN 10 dB
MKR 2.460 87 GHz
-80.90 dBm
10 dB/
POS PK
OFFSET
-30.0
dB
MARKER
2.460 87 GHz
-80.90 dBm
START 2.401 6 GHz
RES BW 1 MHz
VBW 3 MHz
STOP 2.500 0 GHz
SWP 20.0 msec

Accuracy of Measurement

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

Contribution (Line Conducted)	Probability Distribution	Uncertainty (+/- dB)	
		9kHz-150MHz	150-30 MHz
Receiver specification	Rectangular	1.5	1.5
LISN coupling specification	Rectangular	1.5	1.5
Cable and input attenuator calibration	Normal (k=2)	0.3	0.5
Mismatch: Receiver VRC Γ_1=0.03 LISN VRC Γ_R=0.8 (9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1 +/-$\Gamma_1\Gamma_R$)	U-Shaped	0.2	0.35
System repeatability	Std. deviation	0.2	0.05
Repeatablility of EUT		-	-
Combined standard uncertainty	Normal	1.26	1.30
Expanded uncertainty	Normal (k=2)	2.5	2.6

Calculations for 150 kHz to 30 MHz:

$$u_c(y)=\sqrt{\sum_{i=1}^{m} u_i^2(y)} \quad =+/-\sqrt{\frac{1.5^2+1.5^2}{3}+(\frac{0.5}{2})^2+\frac{0.05^2}{2}+0.35^2}=+/-1.298dB$$

$$U=2U_c(y)=+/-2.6dB$$

Contribution (Radiated Emissions)	Probability Distribution	Uncertainties (+/-dB)	
		3 m	10 m
Ambient Signals		-	-
Antenna factor Calibration	Normal (k=2)	+/- 1.0	+/- 1.0
Cable loss Calibration	Normal (k=2)	+/- 0.5	+/- 0.5
Receiver specification	Rectangular	+/- 1.5	+/- 1.5
Antenna directivit	Rectangular	+ 0.5/-0	+ 0.5
Antenna factor variaton with height	Rectangular	+/- 2.0	+/- 0.5
Antenna phase centre variation	Rectangular	0.0	+/- 0.2
Antenna factor frequency interpolation	Rectangular	+/- 0.25	+/- 0.25
Measurement distance variation	Rectangular	+/- 0.6	+/- 0.4
Site imperfections	Rectangular	+/- 2.0	+/- 2.0
Mismatch: Receiver VRC Γ1= 0.2 Antenna VRC Γ_R = 0.67 (Bi) 0.3 (Lp) Uncertainty limits 20Log(1+/- $\Gamma_1\Gamma_R$)	U-Shaped	+ 1.1 - 1.25	+/- 0.5
System repeatability	Std. Deviation	+/- 0.5	+/- 0.5
Repeatability of EUT		-	-
Combined Standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculations for 3m biconical antenna. Coverage factor of k=2 will ensure that the level of confidence will be approximately 95%, therefore:

U = 2uc(y) = 2 x +/- 2.19 = +/-4.38 dB

Test Equipment

Type	Model	Cal. Due Date	S/N
Microwave Spectrum Analyzer	HP8566B (100Hz-22GHz)	08/15/98	3638A08713
Microwave Spectrum Analyzer	HP8566B (100Hz-22GHz)	04/17/99	2542A11898
Spectrum Analyzer/Tracking Gen.	HP8591A (100Hz-1.8GHz)	08/10/98	3144A02458
Signal Generator*	HP8640B (500Hz-1GHz)	08/09/98	2232A19558
Signal Generator*	HP8640B (500Hz-1GHz)	08/09/98	1851A09816
Signal Generator*	Rohde & Schwarz (0.1-1000MHz)	09/11/98	894215/012
Ailtech/Eaton Receiver	NM37/57A-SL (30-1000MHz)	04/12/99	0792-03271
Ailtech/Eaton Receiver	NM37/57A (30-1000MHz)	03/11/99	0805-03334
Ailtech/Eaton Receiver	NM17/27A (0.1-32MHz)	09/17/98	0608-03241
Quasi-Peak Adapter	HP85650A	08/15/98	2043A00301
Ailtech/Eaton Adapter	CCA-7 CISPR/ANSI QP Adapter	03/11/99	0194-04082
RG58 Coax Test Cable	No. 167		n/a
Harmonic/Flicker Test System	HP 6841A (IEC 555-2/3)		3531A00115
Broadband Amplifier (2)	HP8447D		1145A00470, 1937A03348
Broadband Amplifier	HP8447F		2443A03784
Transient Limiter	HP11947A (9kHz-200MHz)		2820A00300
Horn Antenna	EMCO Model 3115 (1-18GHz)		9704-5182
Horn Antenna	EMCO Model 3115 (1-18GHz)		9205-3874
Horn Antenna	EMCO Model 3116 (18-40GHz)		9203-2178
Biconical Antenna (4)	Eaton 94455/Eaton 94455-1/Singer 94455-1/Compliance Design		1295, 1332, 0355
Log-Spiral Antenna (3)	Ailtech/Eaton 93490-1		0608, 1103, 1104
Roberts Dipoles	Compliance Design (1 set)		
Ailtech Dipoles	DM-105A (1 set)		33448-111
EMCO LISN	3816/2		1079
EMCO LISN	3816/2		1077
EMCO LISN	3725/2		2009
Microwave Preamplifier 40dB Gain	HP83017A (0.5-26.5GHz)		3123A00181
Microwave Cables	MicroCoax (1.0-26.5GHz)		
Ailtech/Eaton Receiver	NM37/57A-SL		0792-03271
Spectrum Analyzer	HP8594A		3051A00187
Spectrum Analyzer (2)	HP8591A		3034A01395, 3108A02053
Modulation Analyzer	HP8901A		2432A03467
NTSC Pattern Generator	Leader 408		0377433
Noise Figure Meter	HP 8970B		3106A02189
Noise Figure Meter	Ailtech 7510		TE31700
Noise Generator	Ailtech 7010		1473
Microwave Survey Meter	Holaday Model 1501 (2.450GHz)		80931
Digital Thermometer	Extech Instruments 421305		426966
Attenuator	HP 8495A (0-70dB) DC-4GHz		
Bi-Directional Coax Coupler	Narda 3020A (50-1000MHz)		
Shielded Screen Room	RF Lindgren Model 26-2/2-0		6710 (PCT270)
Shielded Semi-Anechoic Chamber	Ray Proof Model S81		R2437 (PCT278)
Enviromental Chamber	Associated Systems Model 1025 (Temperature/Humidity)		PCT285

* Calibration traceable to the National Institute of Standards and Technology (NIST).

Recommendation/Conclusion

The data collected shows that the **LG Electronics Inc. (GoldStar Model: *MV-1520M*) Microwave Oven FCC ID: BEJV152XD** complies with Part 18 of the FCC Rules.