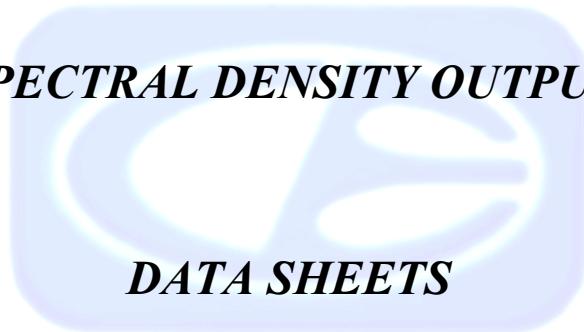


***SPECTRAL DENSITY OUTPUT***  
  
***DATA SHEETS***

---

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114 Olinda Drive  
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**Lake Forest Division**  
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(949) 587-0400

## SPECTRAL DENSITY - LOW CH. - STEP A

REF 100.0 dB $\mu$ V ATTN 10 dB

MKR 2.401 85 GHz

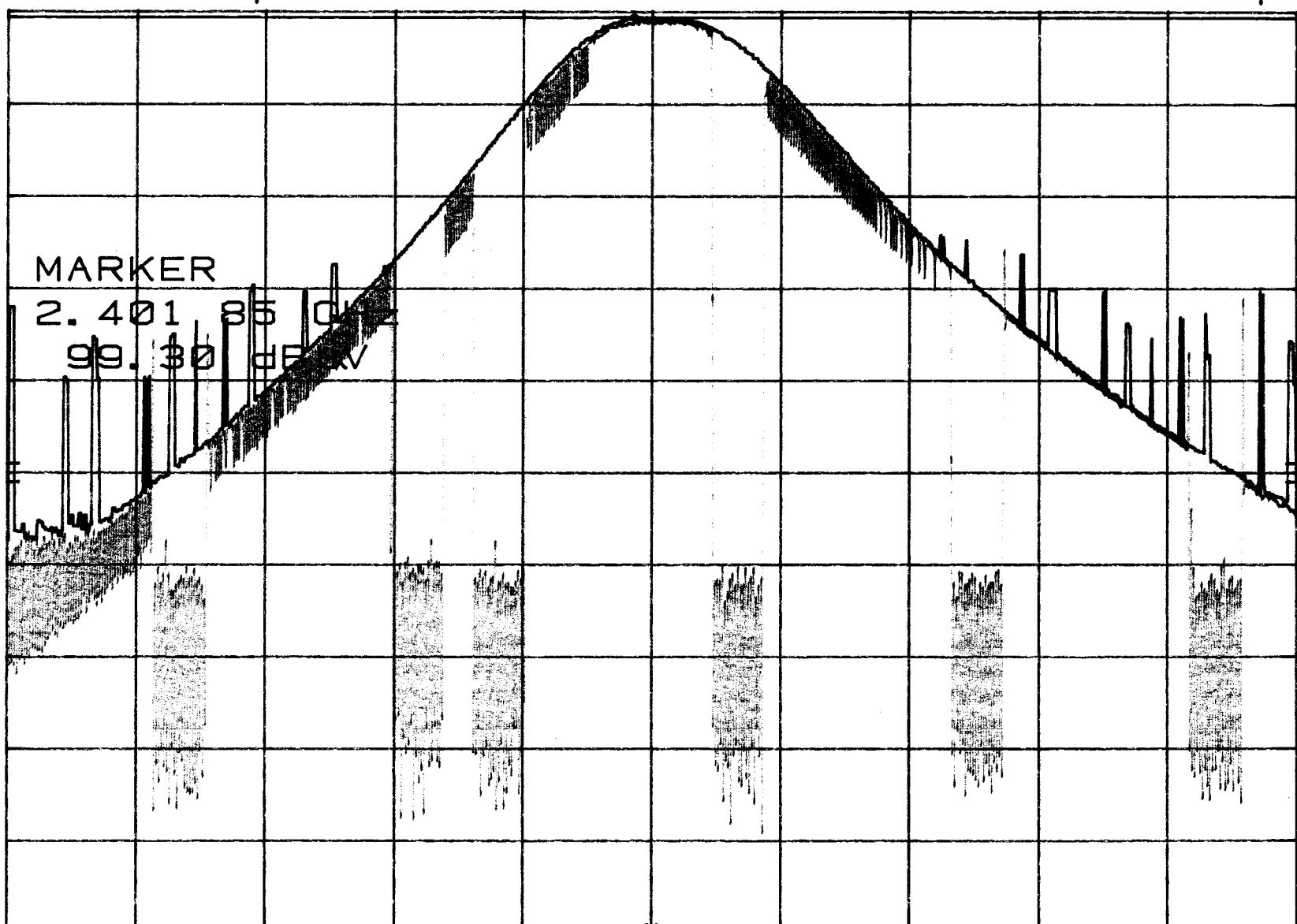
99.30 dB $\mu$ V

HP

10 dB/

DL  
99.3  
dB $\mu$ V

CORR'D



CENTER 2.402 0 GHz

RES BW 1 MHz

VBW 1 MHz

SPAN 10.0 MHz

SWP 20.0 msec

SPECTRAL DENSITY - LOW CH. - STEP A  
REF 100.0 dB $\mu$ V ATTN 10 dB

MKR 2.402 007 5 GHz  
90.40 dB $\mu$ V

hp

10 dB/

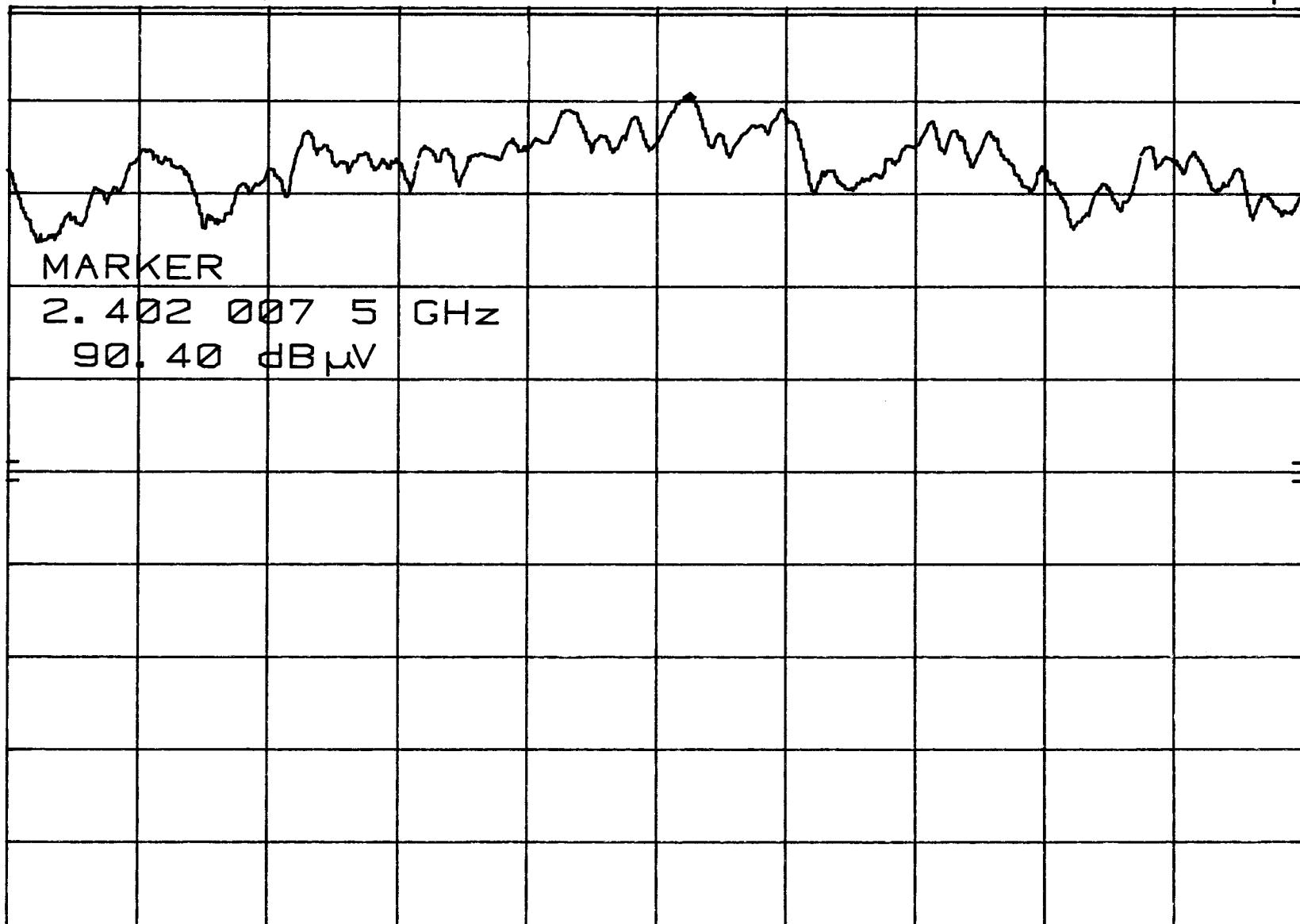
DL  
99.3  
dB $\mu$ V

CORR'D

CENTER 2.402 000 GHz  
RES BW 3 kHz

VBW 10 kHz

SPAN 300 kHz  
SWP 100 sec



SPECTRAL DENSITY - MID CH. - STEP A  
REF 100.0 dB $\mu$ V ATTEN 10 dB

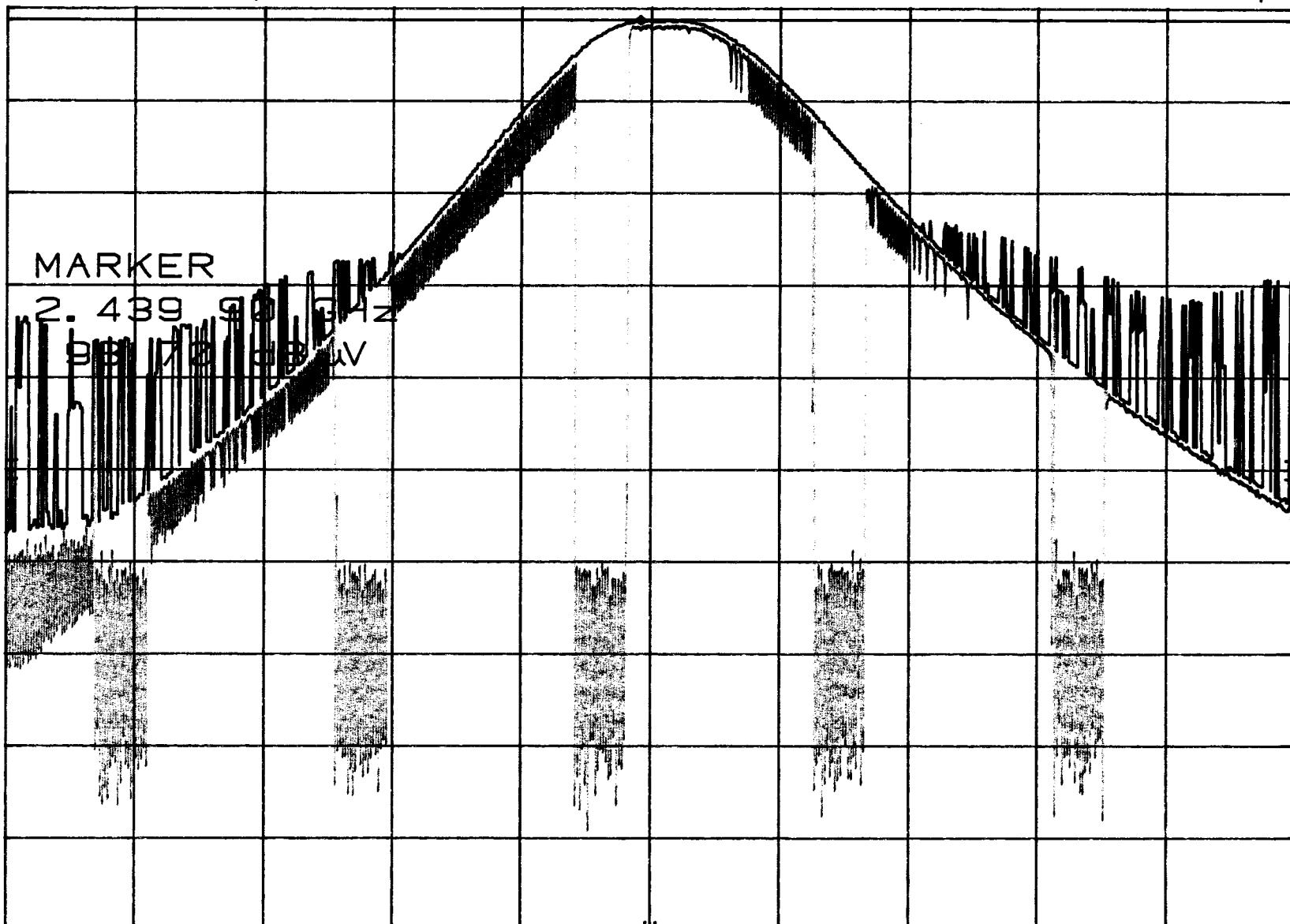
MKR 2.439 90 GHz  
98.70 dB $\mu$ V

hp

10 dB/

DL  
98.7  
dB $\mu$ V

CORR'D



CENTER 2.440 0 GHz  
RES BW 1 MHz

VBW 1 MHz

SPAN 10.0 MHz  
SWP 20.0 msec

SPECTRAL DENSITY - MID CH. - STEP A

MKR 2.440 005 1 GHz

REF 100.0 dB $\mu$ V ATTEN 10 dB

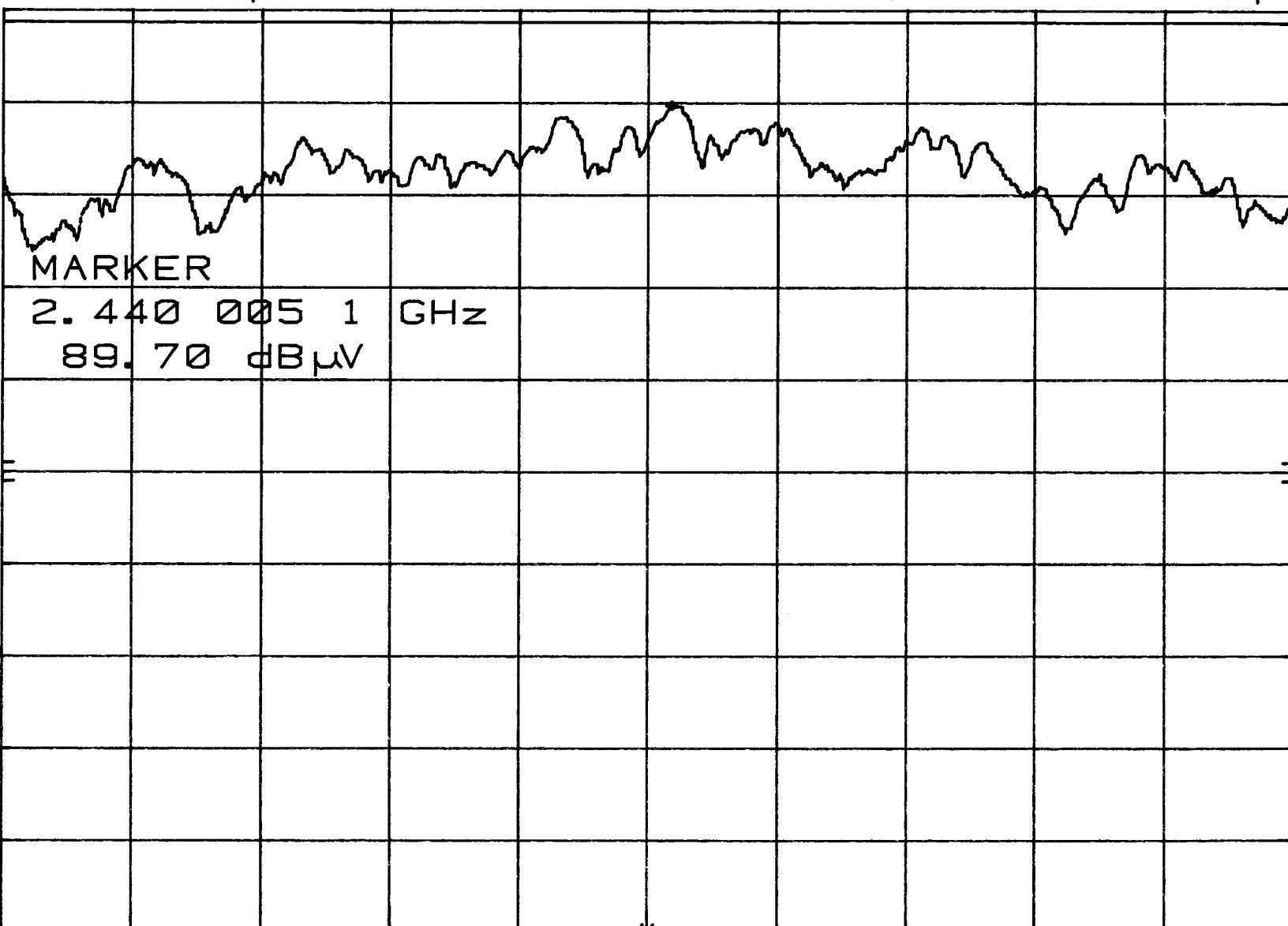
89.70 dB $\mu$ V

HP

10 dB/

DL  
98.7  
dB $\mu$ V

CORR'D



CENTER 2.440 000 GHz  
RES BW 3 kHz

VBW 10 kHz

SPAN 300 kHz  
SWP 100 sec

SPECTRAL DENSITY - HIGH CH. - PART A  
REF 100.0 dB $\mu$ V ATTN 10 dB

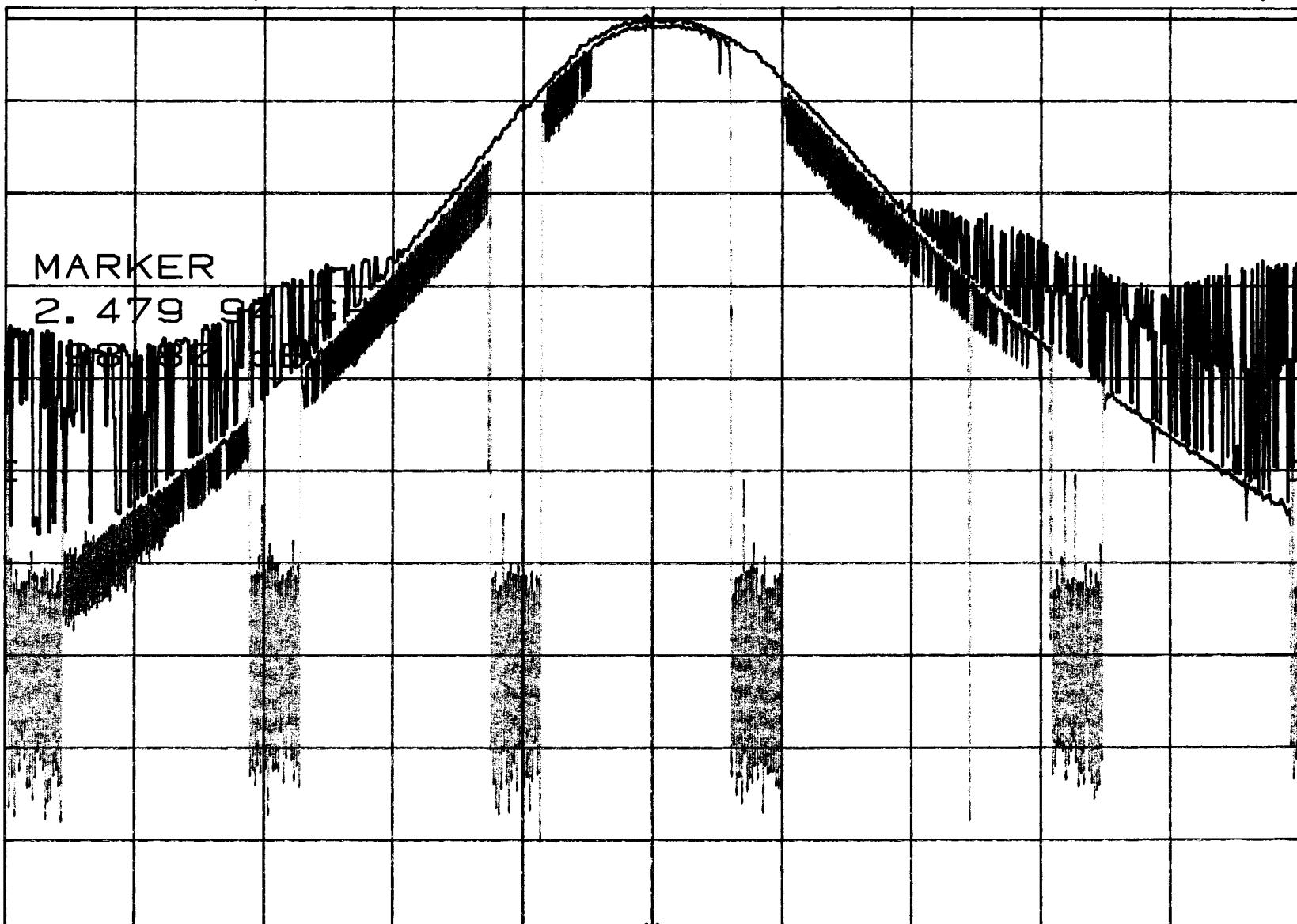
MKR 2.479 94 GHz  
98.80 dB $\mu$ V

HP

10 dB/

DL  
98.8  
dB $\mu$ V

CORR'D



CENTER 2.480 0 GHz  
RES BW 1 MHz

VBW 1 MHz

SPAN 10.0 MHz  
SWP 20.0 msec

## SPECTRAL DENSITY - HIGH CH. - PART A

MKR 2.480 004 5 GHz

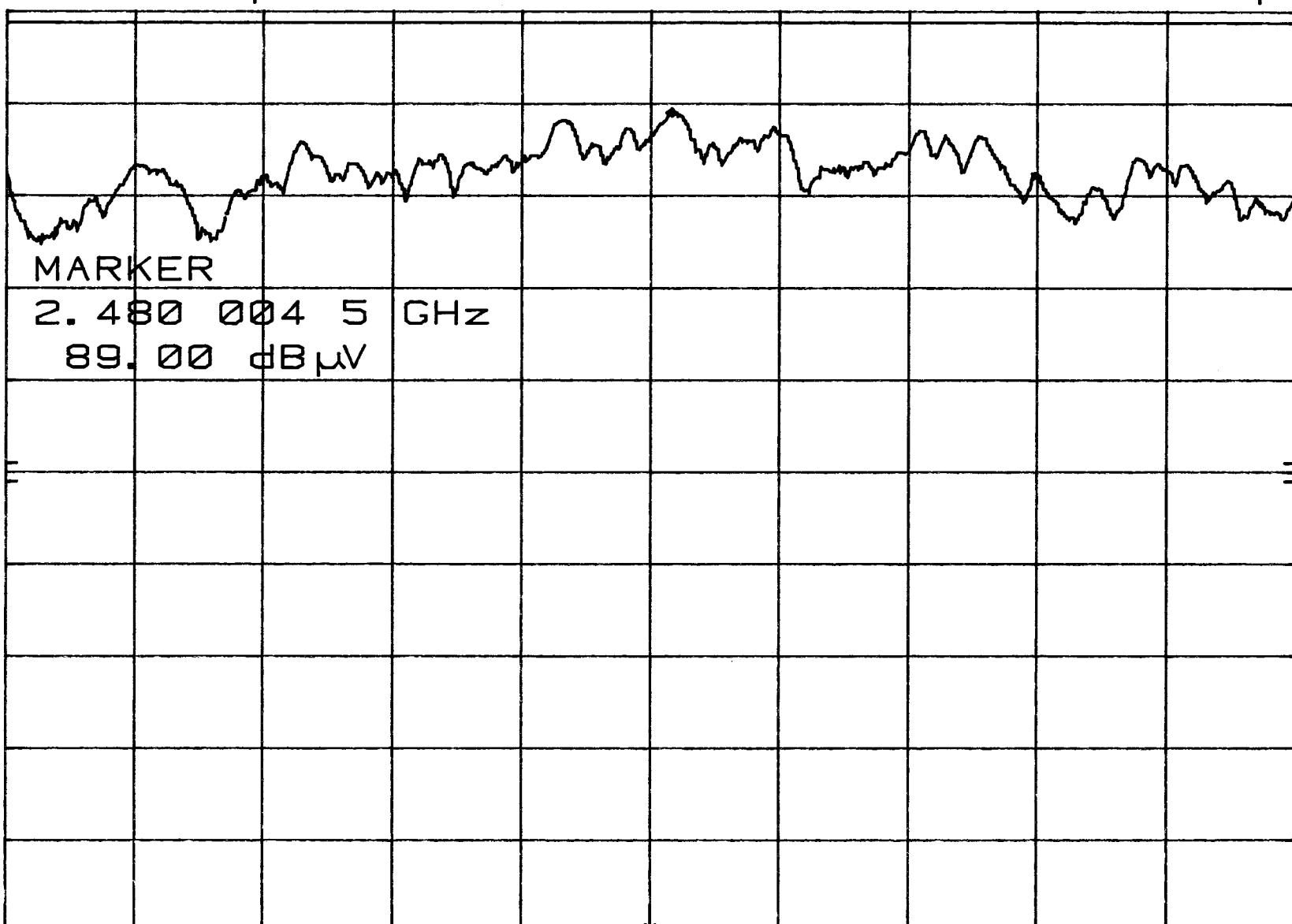
REF 100.0 dB $\mu$ V ATTEN 10 dB89.00 dB $\mu$ V

Hz

10 dB/

DL  
98.8  
dB $\mu$ V

CORR'D

CENTER 2.480 000 GHz  
RES BW 3 kHz

VBW 10 kHz

SPAN 300 kHz  
SWP 100 sec

## RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.247)

COMPANY	INSIDE OUT NETWORKS	DATE	2/6/03	
EUT	Bluetooth Class 2 Module	DUTY CYCLE	N/A	%
MODEL	55001074	PEAK TO AVG	N/A	dB
S/N	N/A	TEST DIST.	3	Meters
TEST ENGINEER	Kyle Fujimoto	LAB	D	

\* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

\*\* DELTA = SPEC LIMIT - CORRECTED READING

PAGE 1

## SPECTRAL DENSITY OUTPUT

### INSIDE OUT NETWORKS

### BLUETOOTH CLASS 2 MODULE

MODEL: 55001074

CHANNEL	PEAK POWER OUTPUT (dBm)
LOW	-5.64
MIDDLE	-6.24
HIGH	-6.74

## ***NUMBER OF HOPPING FREQUENCIES***

***DATA SHEET***

---

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NUMBER OF CHANNELS

REF 107.0 dB $\mu$ V ATTEN 10 dB

MKR 2.401 00 GHz

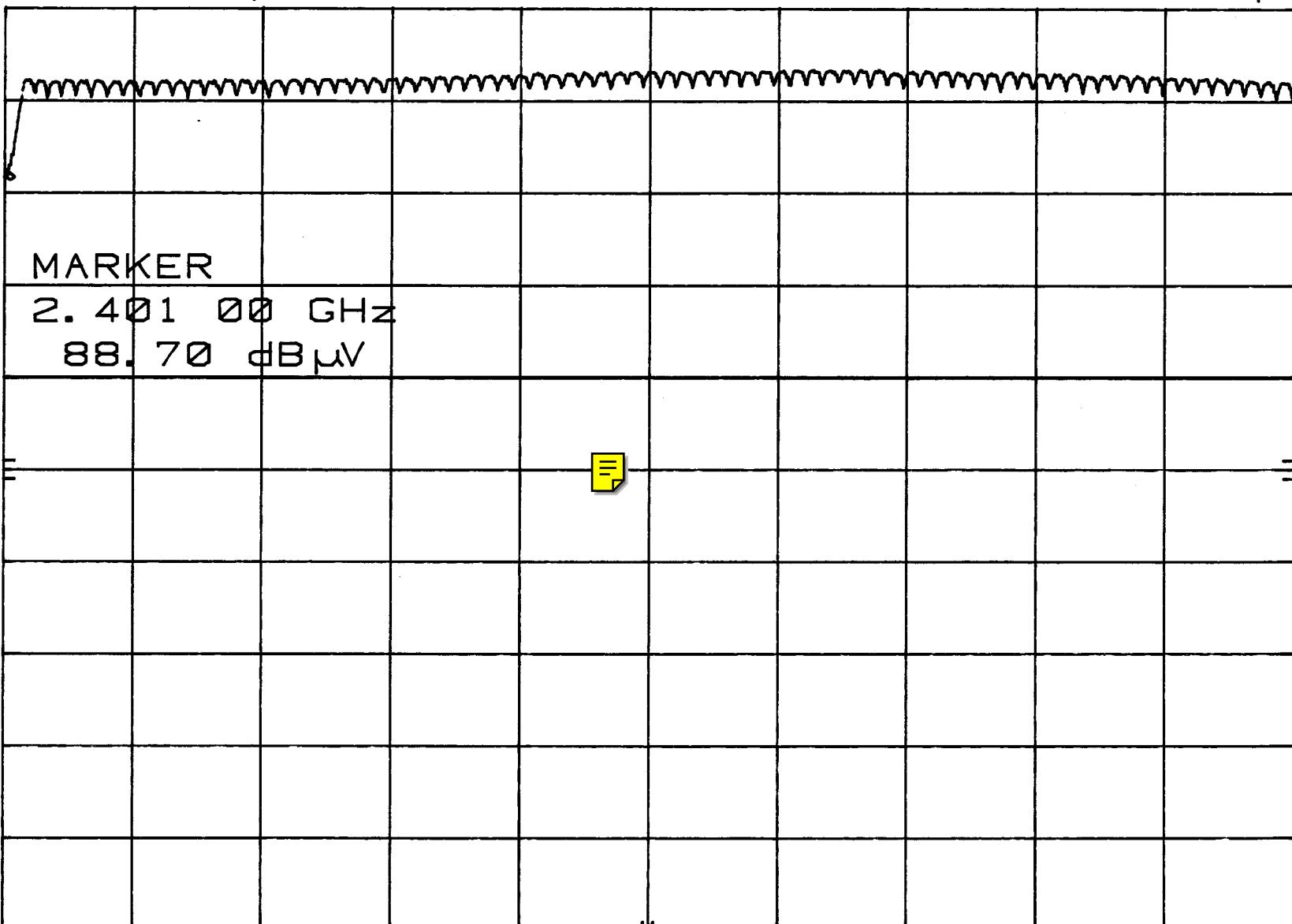
88.70 dB $\mu$ V

hp

10 dB/

DL  
67.0  
dB $\mu$ V

CORR'D



START 2.401 0 GHz  
RES BW 1 MHz

VBW 1 MHz

STOP 2.481 0 GHz  
SWP 20.0 msec

MARKER  
2.401 00 GHz  
88.70 dB $\mu$ V

## ***DUTY CYCLE***

## ***INFORMATION AND DATA SHEET***

---

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Company:15.247 Interpretation	Subject:Spurious emission	1227
<b>Remarks:</b>		<b>Keyword:</b>
Rule Parts:15.247	City:	State: Country:
<p>INQUIRY: I'm writing the regulatory sections for a new wireless standard, the IEEE 802.15.4 Personal Area Network standard. This is the IEEE's answer to a need for something a bit lower cost than Bluetooth. Since these standards have in the past not done a particularly good job of documenting and interpreting FCC and other applicable regs, I'm really making a special effort to get it right for these guys. However, I've run into a problem on interpretation of Part 15.247 that no one knows the answer to, though it is quite fundamental and should have probably been spelled out in the rules. 15.247 allows harmonics at -20 dBc (easy) for ISM band spread spectrum equipment, but where the harmonics fall in the restricted bands of FCC 15.205 the general level of FCC 15.209 must be met. This is 500 uV/m at 3 meters, or -41.2 dBm ERP. The 2nd, 3rd, and 5th harmonics of 2400 MHz band gear falls into restricted, as does the 3rd and 5th of 902-928 MHz. At a transmit power level of 100 mW steady state, the equipment must attain -61 dBc harmonic rejection, or with higher antenna gain (say on the third where a quarterwave whip resonates) it must get even more. This is a real bear for cheap gear to meet. Now it is common practice to use the provisions of FCC 15.35 to average the transmission over 100 mS and allow the electric field strength to go up inversely with the average from 0 to 100% duty cycle. This may be done to a maximum of 20 dB allowed higher spurious emissions. For example, at 10% duty cycle over 100 mS, the electric field of harmonics may go up 10X, and since power is the square of electric field the peak power of spurs landing in restricted bands may go up 100X, or 20 dB. This is the max allowed, and in this case it makes a hell of a difference. Now the key question is: Do the averaging provisions of FCC 15.35 apply to hoppers? This is true if the standard practice when measuring frequency hopping systems for harmonics is to let the transmitter hop while the test system takes its data in a fixed 1 MHz channel that the system hops through. Or, has the standard practice been to FORCE the transmitter to transmit on a fixed non-hopping frequency and measure harmonics on a fixed channel using the averaging detector? I have pinged the Part 15 author, John Reed, and he is apparently not sure how he intended this to be interpreted when he wrote the rules. Both he and Ray Laforge have referred me to you on this key question. If a policy on this has not been previously spelled out, then whatever is standard practice on Bluetooth would seem to be the standard for all ISM band hopping systems. On the Bluetooth standard with 79 channels, 1600 hops per second, and an average of two hits on a test channel per 100 mS test period, the full 20 dB relaxation on spurious emissions would be attained. This basically allows about 40 dB harmonic suppression (not so hard to get) vs. 60 if the relaxation via averaging does not apply RESPONSE: The spurious emissions that fall in the restricted bands above 1 GHz would be subject to a peak field strength level at 3 meters of 74 dBuV/m (5000uV/m) and an average field strength level of 54 dBuV/m(500uV/m). The following procedure should be used when measuring the peak level. During these tests the hopping function is disabled. I understand that the hopping channels may overlap in a 1 MHz band in this new proposal. Therefore, the duty factor should take this into account. This was not an issue in the current bluetooth specification as the channel separation is 1 MHz and the 20 db bandwidths do not overlap. Spurious Radiated Emissions This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings: Span = wide enough to fully capture the emission being measured RBW = 1 MHz for f &gt; 1 GHz, 100 kHz for f &lt; 1 GHz VBW &gt; RBW Sweep = auto Detector function = peak Trace = max hold Follow the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data. Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from <math>20\log(\text{dwell time}/100 \text{ ms})</math>, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.</p>		

**Supporting Images:**

ID	Description	File Type

## DUTY CYCLE INFO

REF 0.0 dBm ATTEN 10 dB

MKR  $\Delta$  156.5 msec

-10.60 dB

hp

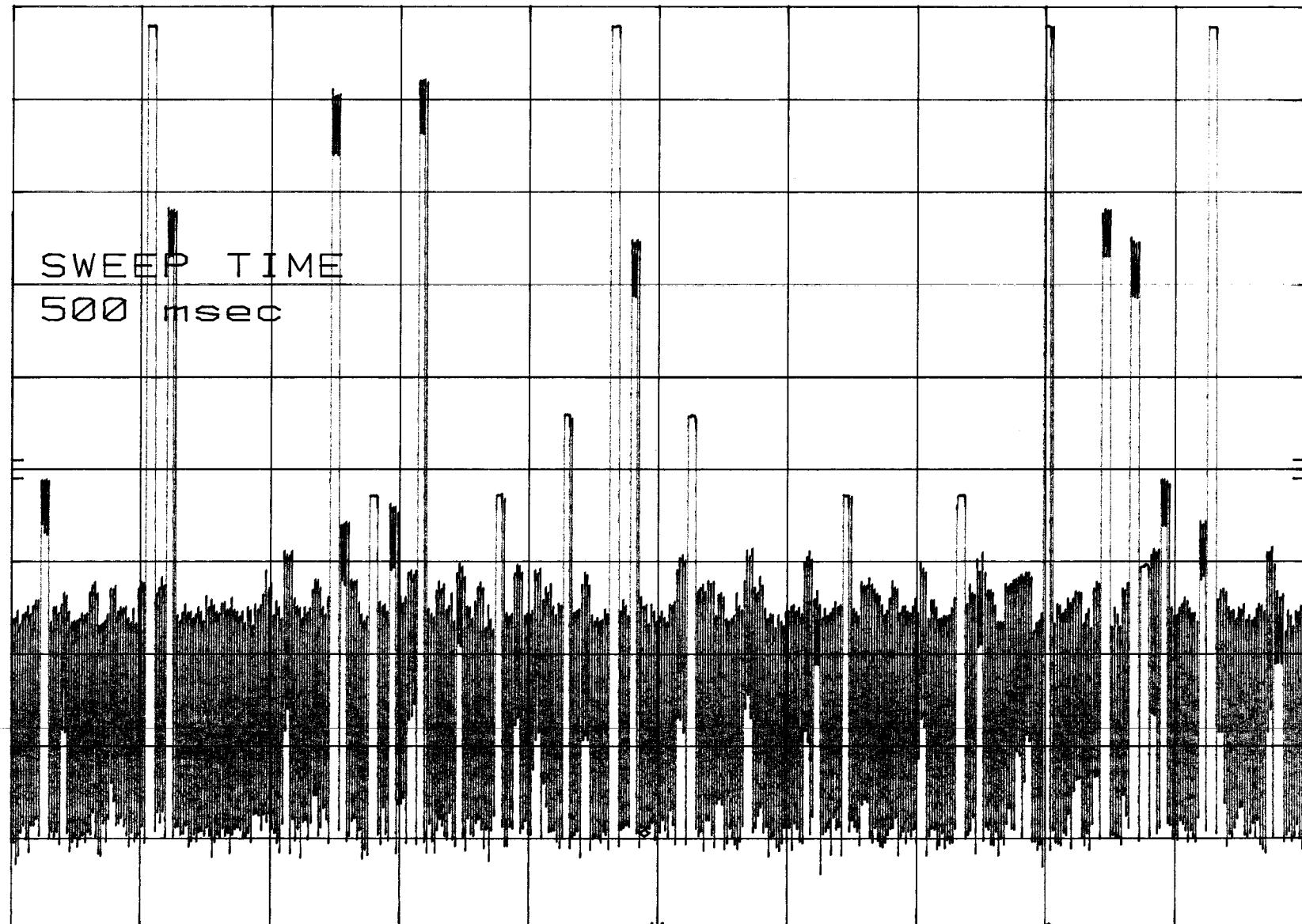
10 dB/

DL  
-40.0  
dBm

CORR'D

SWEEP TIME

500 msec



CENTER 2.442 000 000 GHz

RES BW 1 MHz

VBW 1 MHz

SPAN 0 Hz

SWP 500 msec

***BAND EDGES***

***DATA SHEETS***

---

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**(949) 587-0400**

BAND EDGE AT 2400 MHZ

REF 107.0 dB $\mu$ V ATTEN 10 dB

MKR 2.400 00 GHz

73.80 dB $\mu$ V

HP

10 dB/

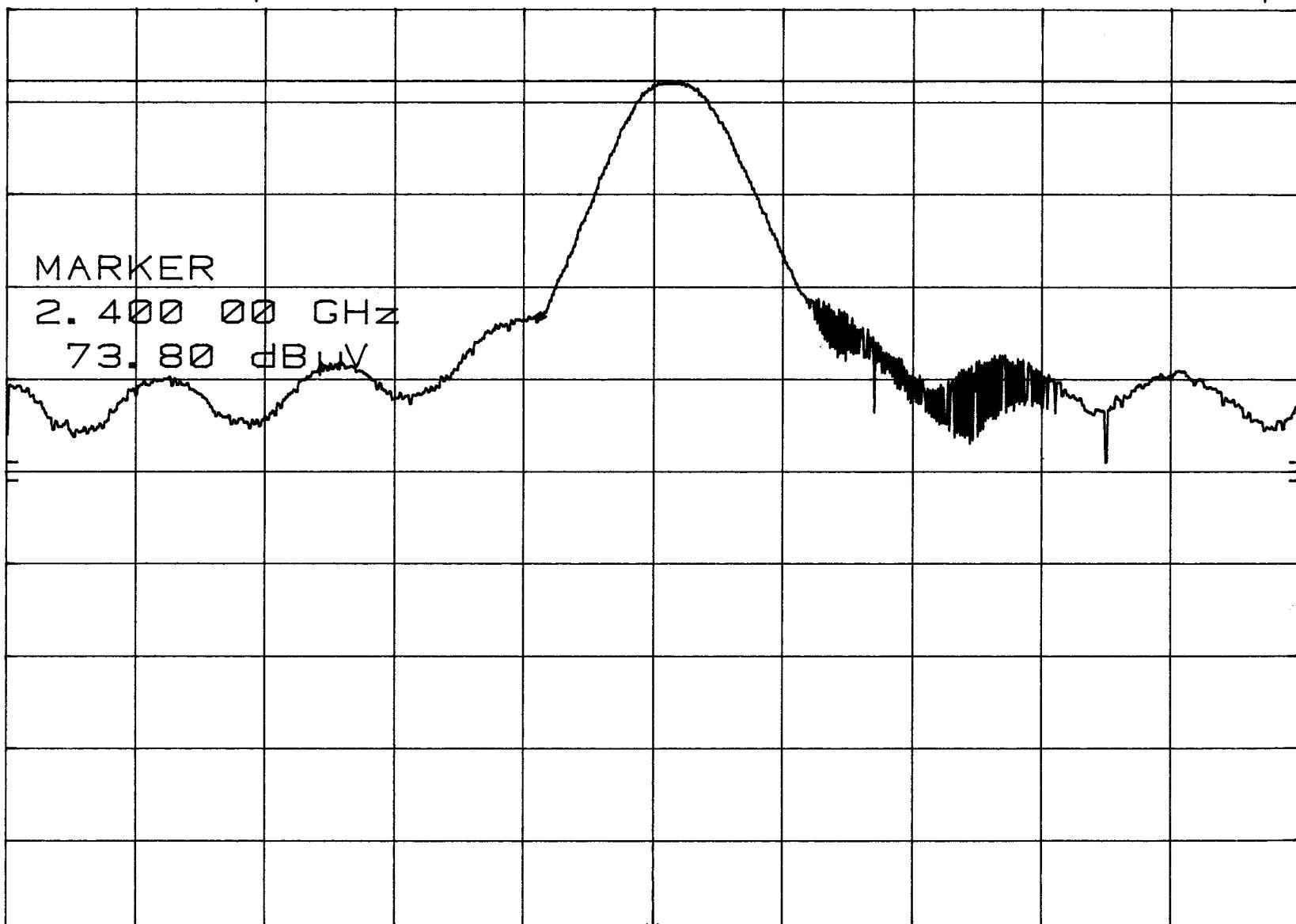
DL  
99.3  
dB $\mu$ V

CORR'D

CENTER 2.401 7 GHz  
RES BW 1 MHz

VBW 1 MHz

SPAN 20.0 MHz  
SWP 20.0 msec



hp

LOW BAND EDGE IN RESTRICTED BAND  
REF 107.0 dB $\mu$ V ATTN 10 dB

MKR 2.376 1 GHz  
66.70 dB $\mu$ V

10 dB/

DL  
99.3  
dB $\mu$ V

MARKER

2.376 1 GHz  
66.70 dB $\mu$ V

CORR'D

CENTER 2.322 GHz

RES BW 1 MHz

VBW 1 MHz

SPAN 200 MHz  
SWP 20.0 msec

hp

LOW BAND EDGE IN RESTRICTED BAND - AVG  
REF 40.0 dB $\mu$ V ATTEN 10 dB

MKR 2.377 767 GHz  
36.22 dB $\mu$ V

LINEAR

DL  
39.3  
dB $\mu$ V

MARKER

2.377 767 GHz

36.22 dB $\mu$ V

CORR'D

CENTER 2.376 52 GHz  
RES BW 1 MHz

VBW 10 Hz

SPAN 4.60 MHz  
SWP 50.0 sec

BAND EDGE - HIGH CH. - STEP 1 - PEAK  
REF 100.0 dB $\mu$ V ATTEN 10 dB

MKR 2.480 04 GHz  
98.80 dB $\mu$ V

hp

10 dB/

DL  
98.8  
dB $\mu$ V

MARKER

2.480 04 GHz  
98.80 dB $\mu$ V

CORR'D



CENTER 2.480 0 GHz

RES BW 1 MHz

VBW 1 MHz

SPAN 10.0 MHz

SWP 20.0 msec

BAND EDGE - HIGH CH. - STEP 1 - AVG  
REF 98.0 dB $\mu$ V ATTEN 10 dB

MKR 2.480 025 2 GHz  
88.55 dB $\mu$ V

hp

LINEAR

DL  
97.9  
dB $\mu$ V

MARKER

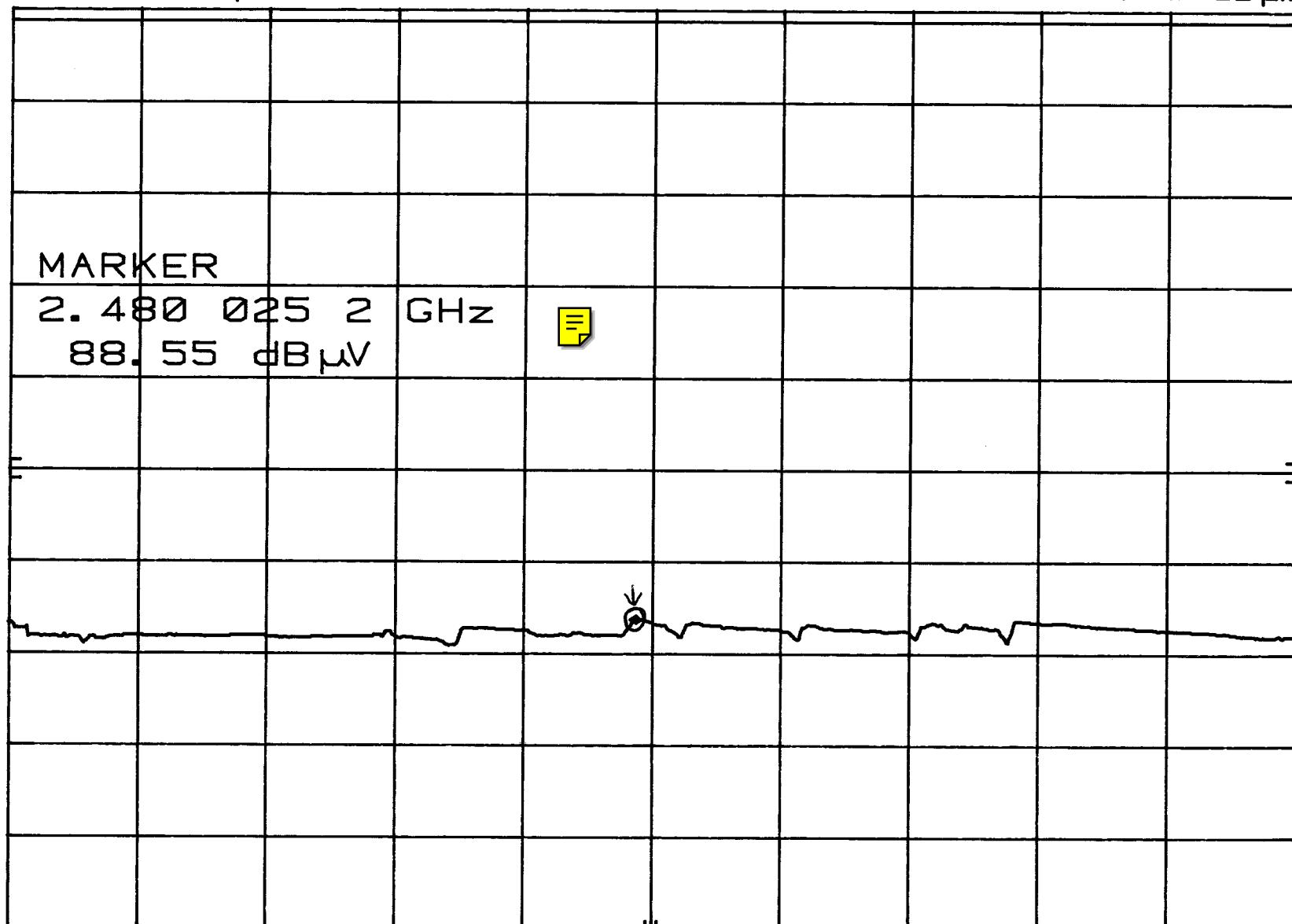
2.480 025 2 GHz  
88.55 dB $\mu$ V

CORR'D

CENTER 2.480 030 GHz  
RES BW 1 MHz

VBW 10 Hz

SPAN 340 kHz  
SWP 50.0 sec



BAND EDGE - HIGH CH - STEP 2 - DELTA

MKR  $\Delta$  5.058 MHz

REF 100.0 dB $\mu$ V ATTEN 10 dB

-44.40 dB

hp

10 dB/

DL  
98.8  
dB $\mu$ V

CORR'D

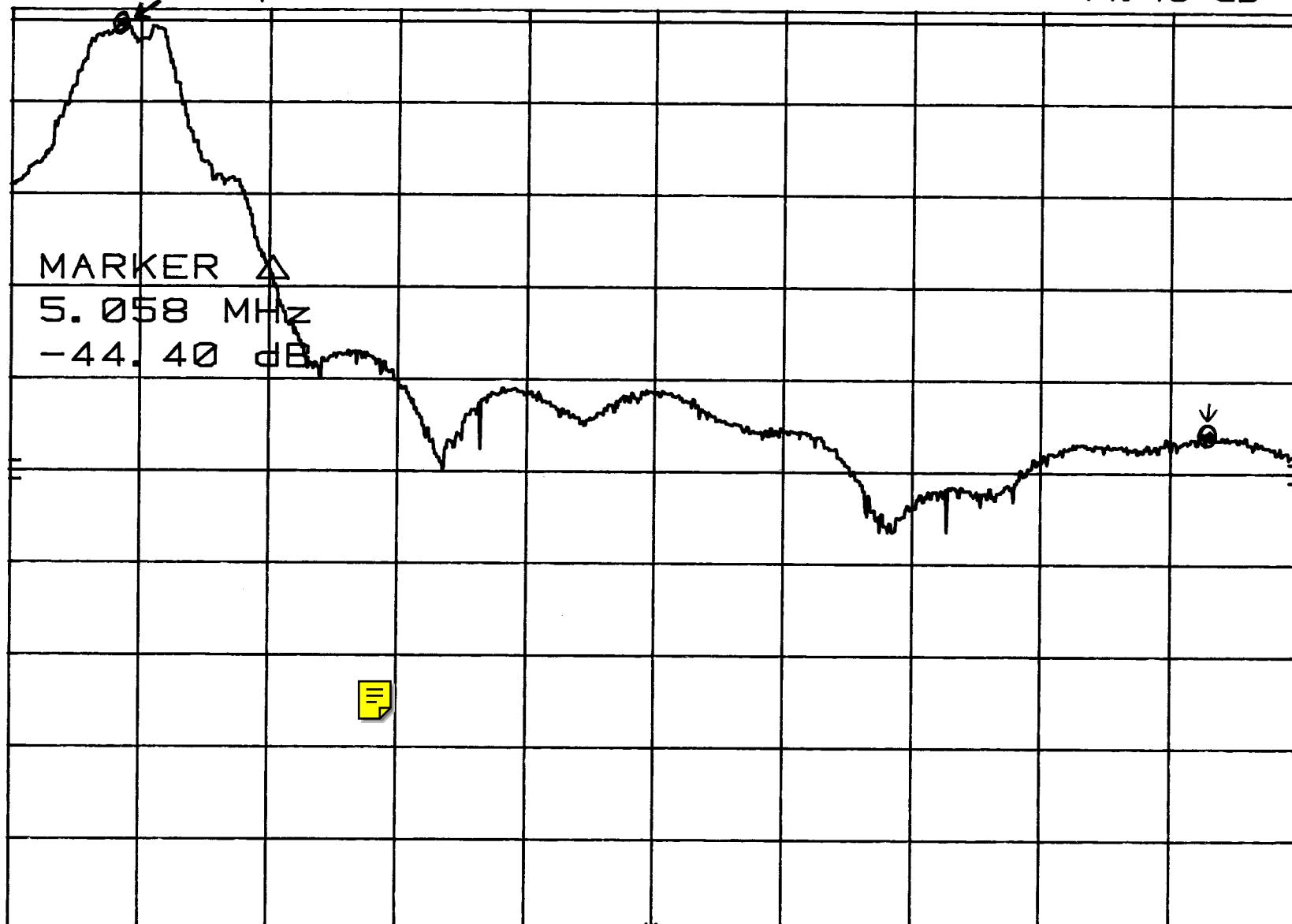
START 2.479 47 GHz

RES BW 100 kHz

VBW 100 kHz

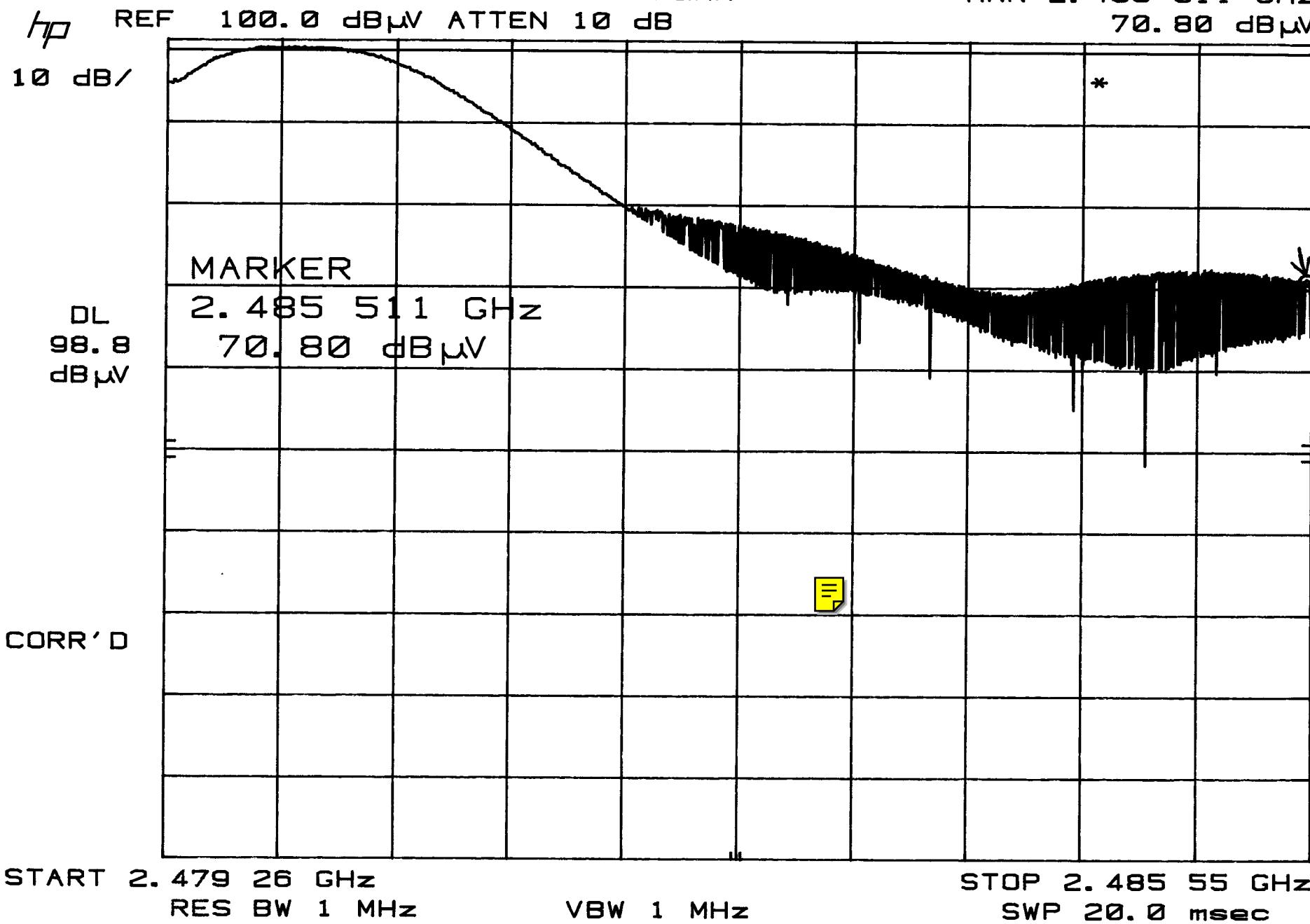
STOP 2.485 47 GHz

SWP 20.0 msec



BAND EDGE AT 2485.5 MHZ - PEAK  
REF 100.0 dB $\mu$ V ATTEN 10 dB

MKR 2.485 511 GHz  
70.80 dB $\mu$ V



hp

BAND EDGE AT 2485.5 MHZ - AVG  
REF 37.0 dB $\mu$ V ATTEN 10 dB

MKR 2.485 504 09 GHz  
34.40 dB $\mu$ V

LINEAR

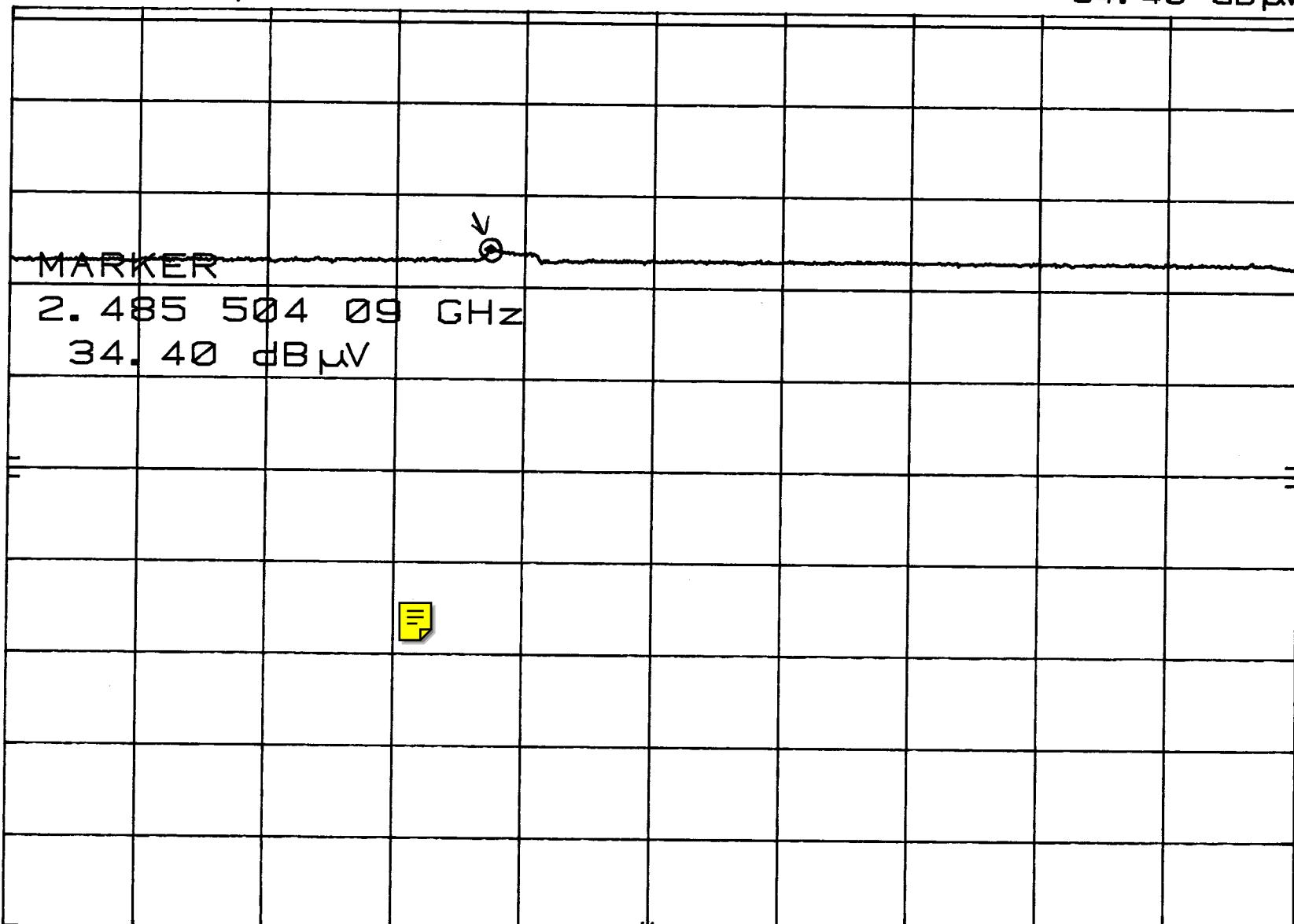
DL  
36.9  
dB $\mu$ V

CORR'D

START 2.485 500 0 GHz  
RES BW 1 MHz

VBW 10 Hz

STOP 2.485 511 0 GHz  
SWP 50.0 sec



## RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.247)

<b>COMPANY</b>	<b>INSIDE OUT NETWORKS</b>	<b>DATE</b>	<b>2/6/03</b>	
<b>EUT</b>	<b>Bluetooth Class 2 Module</b>		<b>DUTY CYCLE</b>	N/A %
<b>MODEL</b>	<b>55001074</b>		<b>PEAK TO AVG</b>	N/A dB
<b>S/N</b>	<b>N/A</b>		<b>TEST DIST.</b>	3 Meters
<b>TEST ENGINEER</b>	<b>Kyle Fujimoto</b>		<b>LAB</b>	<b>D</b>

\* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

\*\* DELTA = SPEC LIMIT - CORRECTED READING

PAGE 1