

MEASUREMENT AND TECHNICAL REPORT

HM ELECTRONICS
6675 Mesa Ridge Road
San Diego, CA 92121-2937

DATE: 05 December 2000

This Report Concerns:	Original Grant: ☒	Class II Change: ☐
Equipment Type:	COM400CC, Model K23724	
Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?	Yes: ☐ Defer until:	No: ☒
Company Name agrees to notify the Commission by:	N/A	
of the intended date of announcement of the product so that the grant can be issued on that date.		
Transition Rules Request per 15.37?	Yes: ☐	*No: ☐
(*) FCC Part 2, Paragraphs 2.1053, 2.1049, 2.1051; and Part 90, Paragraph 90.217		
Report Prepared by: TÜV PRODUCT SERVICE 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 546 3999 Fax: 858 546 0364		

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1 GENERAL INFORMATION

1.1 Product Description

Components of EUT			
Description	Model Number	Serial Number	FCC ID Number
Collar Communicator COM400CC	K23724	--	BYMCOM400CC
OPERATING MODE(S):		Normal	
I/O CABLES			
Headset connector, analog, (1), No shielding; 5-pin custom connector; audio port termination; appx. 1' cable; removable			
POWER CORDS			
N/A, battery operated			
POWER INTERFACE			
FREQUENCY/AC/DC VOLTAGE:		Battery, DC	
INTERFACING AND/OR SIMULATORS PERIPHERAL EQUIPMENT:			
DESCRIPTION	MODEL #	SERIAL #	FCC ID
Headset	HS11	--	None

1 GENERAL INFORMATION (continued)

1.2 Related Submittal/Grant

None

1.3 Tested System Details

The FCC IDs for all equipment, plus descriptions of all cables used in the tested system are:

None

1.4 Test Methodology

Purpose of Test: To demonstrate compliance with the ANSI C63.4 setup.

Test Performed:

- x 1. Conducted Emissions, FCC Part 2, Paragraphs 2.1049, 2.1051, & Part 90, Paragraph 90.217
- 2. Radiated Emissions, EN55022: 1992 Class B limit, 30 - 1,000 MHz, 10 meters
- x 3. Radiated Emission per FCC Part 2, Paragraph 2.1053
- 4. Engineering evaluations

1.5 Test Facility

The open area test site and conducted measurement data were tested by:

TÜV PRODUCT SERVICE
10040 Mesa Rim Road
San Diego, CA 92121-2912
Phone: 619 546 3999
Fax: 619 546 0364

The Test Site Data and performance comply with ANSI 63.4 and are registered with the FCC, 7435 Oakland Mills Rd, Columbia Maryland 21046. All Measurement Data is acquired according to the content of FCC Measurement Procedure and ANSI C63.4, unless supplemented with additional requirements as noted in the test report.

1.6 Part 2 Requirements

Frequency Range: Transmit: 468.4875 to 469.8875 MHz
Receive: 457.5125 to 467.6125 MHz

Maximum Power Rating: 50 mW

DC Voltages applied to dc currents into the final radio frequency amplifying device for normal operation over the power range:

Final gain stage on the transmit strip is Q5.

Q5 collector is 5 Vdc

Q5 collector I is 20 mA

Values at 50 mW power rating. 50 mW is the only setting that is used.

Q5 base is 3.5 Vdc

Q5 base I is 1 mA

Description of all circuitry and devices provided for determining and stabilizing frequency:

Transmit frequency is determined by phase locked loop on the 1st mixer (IC2) IC on the transceiver board. See writeup on transceiver board theory of operation.

Description of circuits or devices employed for suppression of spurious radiation, for limiting modulation, and for limiting power:

Modulation is limited by the AK2345 tone chip IC6 on the transceiver board. The IC has an internal limiter circuit. Power is limited by the supply voltage. Spurious signals are suppressed by saw filter (FL3) and by out filter (L7, L8, L9, C32, C33, C37, C38, C39).

2. SYSTEM TEST CONFIGURATION

2.1 Justification

The COM400CC, Model K23724 was initially tested for FCC emission in the following configuration:

See Block Diagram.

2.2 EUT Exercise Software

None

2.3 Special Accessories

None

2.4 Modification

None

2.5 Configuration of Tested System

See Block Diagram.

3 RADIATED EMISSION DATA/EQUIPMENT

The following data lists the significant emission frequencies, measured levels, correction factor (which includes cable and antenna corrections), the corrected reading, and the limit.

See following page(s).

Radiated Electromagnetic Emissions



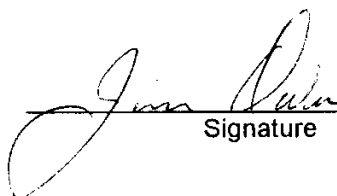
Test Report #: **S0411 Run 02** Test Area: Site 1 3 meters
 Test Method: Spurious Emissions 2.1/53 Test Date: 25-Oct-2000
 EUT Model #: COM400CC EUT Power: Internal Battery
 EUT Serial #: K23724 w/HS5-LT
 Manufacturer: HM Electronics
 EUT Description: Intercom System
 Notes: Transmit Mode

Temperature: 25 °C
 Relative Humidity: 45 %
 Air Pressure: 100.0 kPa
 Page: 1 of 2

Level Key	
PK – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av – Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dBm) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 90.210(c)	N/A
Low Channel						
468.49	77.1 Qp	6.0 / 17.6 / 0.0	100.7	V / 1.0 / 0.0	N/A	N/A
936.98	36.6 Qp	9.0 / 23.5 / 0.0	69.1	V / 1.0 / 0.0	-13.2	N/A
936.98	43.1 Qp	9.0 / 23.5 / 0.0	75.6	H / 1.0 / 0.0	-6.7	N/A
468.49	76.2 Qp	6.0 / 17.6 / 0.0	99.8	H / 1.0 / 0.0	N/A	N/A
Mid Channel						
469.14	77.6 Qp	6.0 / 17.7 / 0.0	101.3	H / 1.0 / 0.0	N/A	N/A
469.14	75.8 Qp	6.0 / 17.7 / 0.0	99.5	V / 1.0 / 0.0	N/A	N/A
938.28	40.3 Qp	9.0 / 23.4 / 0.0	72.7	V / 1.0 / 0.0	-9.6	N/A
938.28	45.2 Qp	9.0 / 23.4 / 0.0	77.6	H / 1.0 / 0.0	-4.7	N/A
High Channel						
469.89	77.8 Qp	6.0 / 17.7 / 0.0	101.5	H / 1.0 / 0.0	N/A	N/A
469.89	75.5 Qp	6.0 / 17.7 / 0.0	99.2	V / 1.0 / 0.0	N/A	N/A
939.78	37.8 Qp	9.0 / 23.3 / 0.0	70.1	V / 1.0 / 0.0	-12.2	N/A
939.78	45.6 Qp	9.0 / 23.3 / 0.0	77.9	H / 1.0 / 0.0	-4.4	N/A

Tested by: Jim Owen
 Printed


 Signature

Radiated Electromagnetic Emissions



Test Report #: **S0411 Run 01** Test Area: **Site 3 Roof**
 Test Method: **Spurious Emissions** *2.1053* Test Date: **11-Oct-2088**
 EUT Model #: **COM400CC** EUT Power: **Internal Battery**
 EUT Serial #: **K23724 w/HS5-LT**
 Manufacturer: **HM Electronics**
 EUT Description: **Intercom System**
 Notes: **Transmit Mode**

Temperature: **25** °C
 Relative Humidity: **45** %
 Air Pressure: **100.0** kPa
 Page: **1** of **3**

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av – Average	

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dBm) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 (dB) FCC Part 90.210	DELTA2 (dB) N/A
High Band						
1879.50	68.2 Pk	4.2 / 28.3 / 39.8	60.8	H / 1.0 / 202.0	-21.4	N/A
1879.50	67.3 Av	4.2 / 28.3 / 39.8	59.9	H / 1.0 / 202.0	-22.3	N/A
2349.40	70.4 Pk	4.8 / 30.1 / 39.6	65.6	H / 1.2 / 142.0	-16.6	N/A
2349.40	70.2 Av	4.8 / 30.1 / 39.6	65.4	H / 1.2 / 142.0	-16.8	N/A
2819.30	71.8 Pk	5.5 / 31.3 / 39.5	69.1	H / 1.2 / 142.0	-13.1	N/A
2819.30	71.8 Av	5.5 / 31.3 / 39.5	69.1	H / 1.2 / 142.0	-13.1	N/A
3289.20	57.0 Pk	6.3 / 32.3 / 39.4	56.2	H / 1.2 / 142.0	-26.0	N/A
1409.66	62.6 Pk	3.6 / 26.4 / 40.4	52.2	H / 2.0 / 193.0	-30.0	N/A
1409.66	59.0 Pk	3.6 / 26.4 / 40.4	48.6	V / 1.5 / 95.0	-33.6	N/A
1879.50	65.9 Pk	4.2 / 28.3 / 39.8	58.5	V / 1.5 / 278.0	-23.7	N/A
2349.40	63.6 Pk	4.8 / 30.1 / 39.6	58.8	V / 1.5 / 313.0	-23.4	N/A
2819.30	72.7 Pk	5.5 / 31.3 / 39.5	70.0	V / 1.5 / 191.0	-12.2	N/A
3289.20	58.2 Pk	6.3 / 32.3 / 39.4	57.4	V / 1.5 / 172.0	-24.8	N/A
Mid Band						
1407.40	58.6 Pk	3.6 / 26.4 / 40.4	48.2	V / 1.2 / 219.0	-34.0	N/A
1876.50	66.0 Pk	4.2 / 28.3 / 39.8	58.6	V / 1.2 / 180.0	-23.6	N/A
2345.60	65.7 Pk	4.8 / 30.0 / 39.6	60.9	V / 1.2 / 180.0	-21.3	N/A
2345.60	64.6 Av	4.8 / 30.0 / 39.6	59.8	V / 1.2 / 180.0	-22.4	N/A
2814.80	70.1 Pk	5.5 / 31.3 / 39.5	67.4	V / 1.1 / 293.0	-14.8	N/A
2814.80	70.1 Av	5.5 / 31.3 / 39.5	67.4	V / 1.1 / 293.0	-14.8	N/A
3289.20	57.4 Pk	6.3 / 32.3 / 39.4	56.6	V / 2.0 / 158.0	-25.6	N/A
1876.60	68.0 Pk	4.2 / 28.3 / 39.8	60.6	H / 1.5 / 275.0	-21.6	N/A
1876.60	67.1 Av	4.2 / 28.3 / 39.8	59.7	H / 1.5 / 275.0	-22.5	N/A
2345.70	68.7 Pk	4.8 / 30.0 / 39.6	63.9	H / 1.2 / 303.0	-18.3	N/A
2345.70	67.9 Av	4.8 / 30.0 / 39.6	63.1	H / 1.2 / 303.0	-19.1	N/A
2814.80	70.9 Pk	5.5 / 31.3 / 39.5	68.2	H / 1.2 / 303.0	-14.0	N/A
2814.80	70.6 Av	5.5 / 31.3 / 39.5	67.9	H / 1.2 / 303.0	-14.3	N/A
3284.00	56.1 Pk	6.3 / 32.3 / 39.4	55.3	H / 1.2 / 13.0	-26.9	N/A

Tested by: Jim Owen
 Printed

Jim Owen
 Signature

Radiated Electromagnetic Emissions



Test Report #: **S0411 Run 01** Test Area: **Site 3 Roof**
 Test Method: **Spurious Emissions** *2.1053* Test Date: **11-Oct-2088**
 EUT Model #: **COM400CC** EUT Power: **Internal Battery**
 EUT Serial #: **K23724 w/HS5-LT**
 Manufacturer: **HM Electronics**
 EUT Description: **Intercom System**
 Notes: **Transmit Mode**

Temperature: **25** °C
 Relative Humidity: **45** %
 Air Pressure: **100.0** kPa
 Page: **2** of **3**

Level Key	
Pk – Peak	Nb – Narrow Band
Qp – QuasiPeak	Bb – Broad Band
Av – Average	

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1 (dB)	DELTA2 (dB)
(MHz)	(dBuV)	(dB) (dB/m) (dB)	(dBuV/m)	(m) (DEG)	FCC Part 90.210	N/A
1407.40	66.3 Pk	3.6 / 26.4 / 40.4	55.9	H / 1.2 / 12.0	-26.3	N/A
Low Band						
1405.46	69.0 Pk	3.5 / 26.4 / 40.4	58.5	H / 1.5 / 13.0	-23.7	N/A
1873.95	72.9 Pk	4.1 / 28.3 / 39.8	65.5	H / 1.0 / 5.0	-16.7	N/A
1873.95	72.9 Av	4.1 / 28.3 / 39.8	65.5	H / 1.0 / 5.0	-16.7	N/A
2342.44	76.7 Pk	4.8 / 30.0 / 39.6	71.9	H / 1.0 / 5.0	-10.3	N/A
2342.44	76.7 Av	4.8 / 30.0 / 39.6	71.9	H / 1.0 / 5.0	-10.3	N/A
2810.92	78.0 Pk	5.5 / 31.3 / 39.5	75.3	H / 1.0 / 316.0	-6.9	N/A
2810.92	78.0 Av	5.5 / 31.3 / 39.5	75.3	H / 1.0 / 316.0	-6.9	N/A
3279.40	61.6 Pk	6.2 / 32.3 / 39.4	60.8	H / 1.0 / 316.0	-21.4	N/A
3279.40	60.9 Av	6.2 / 32.3 / 39.4	60.1	H / 1.0 / 316.0	-22.1	N/A
3747.90	54.5 Pk	6.9 / 33.6 / 40.0	55.0	H / 1.0 / 316.0	-27.2	N/A
4216.40	54.5 Pk	7.2 / 34.0 / 40.6	55.2	H / 1.0 / 316.0	-27.0	N/A
4684.90	55.1 Pk	7.3 / 34.0 / 40.6	55.9	H / 1.0 / 316.0	-26.3	N/A
1405.50	67.6 Pk	3.5 / 26.4 / 40.4	57.1	V / 1.0 / 343.0	-25.1	N/A
1873.95	68.5 Pk	4.1 / 28.3 / 39.8	61.1	V / 1.0 / 230.0	-21.1	N/A
1873.95	68.5 Av	4.1 / 28.3 / 39.8	61.1	V / 1.0 / 230.0	-21.1	N/A
2342.50	68.5 Pk	4.8 / 30.0 / 39.6	63.7	V / 1.0 / 56.0	-18.5	N/A
2810.90	71.6 Pk	5.5 / 31.3 / 39.5	68.9	V / 1.0 / 56.0	-13.3	N/A
2810.90	71.6 Av	5.5 / 31.3 / 39.5	68.9	V / 1.0 / 56.0	-13.3	N/A
3279.40	54.5 Pk	6.2 / 32.3 / 39.4	53.7	V / 1.1 / 282.0	-28.5	N/A
3747.90	54.5 Pk	6.9 / 33.6 / 40.0	55.0	V / 1.1 / 282.0	-27.2	N/A

Tested by: Jim Owen
 Printed

Jim Owen
 Signature

11

Emissions Test Conditions: RADIATED SPURIOUS EMISSIONS

The measurements were performed at the following test location :

☐ - Test not applicable

- - Roof (Small Open Area Test Site)
- ☐ - Canyon #1 (10- and 30-Meter Open Area Test Site), Carroll Canyon, San Diego
- ☐ - Canyon #2 (3- and 10-Meter Open Area Test Site), Carroll Canyon, San Diego

Testing was performed at a test distance of:

- ☐ - 1 meters
- - 3 meters
- ☐ - 10 meters

Test Equipment Used :

Model #	Manufacturer	Description	Serial #	Prop. #	Cal Date
8566B	Hewlett Packard	Spectrum Analyzer	2311A02209	407	11/01
85662B	Hewlett Packard	Spectrum Analyzer Display	2309A04682	406	11/01
LPB2520/A	Antenna Research	LPB	1169	738	05/01
ESVS30	Rhode & Schwarz	Receiver	833825/003	466	12/00

Remarks: _____

3.1 Field Strength Calculation

If a preamplifier was used during the Radiated Emission Testing, it is required that the amplifier gain must be subtracted from the Spectrum Analyzer (Meter) Reading. In addition, a correction factor for the antenna , cable used and a distance factor, if any, must be applied to the Meter Reading before a true field strength reading can be obtained. In the automatic measurement, these considerations are automatically presented as a part of the print out. In the case of manual measurements and for greater efficiency and convenience, instead of using these correlation factors for each meter reading, the specification limit was modified to reflect these correlation factors at each frequency value so that the meter readings can be compared directly to the modified specification limit. This modified specification limit is referred to as the "Corrected Meter Reading Limit" or simply the CMRL, which is the actual field strength present at the antenna. The quantity can be derived in the following manner:

$$\text{Corrected Meter Reading Limit (CMRL)} = \text{SAR} + \text{AF} + \text{CL} - \text{AG} - \text{DC}$$

Where, SAR = Spectrum Analyzer Reading

AF = Antenna Factor

CL = Cable Loss

AG = Amplifier Gain (if any)

DC = Distance Correction (if any)

Assume the following situation: A meter reading of 29.4 dBuV was obtained from a Class A computing device measured at 83 MHz. Assume an antenna factor of 9.2 dB, a cable loss of 1.4 dB and amplifier gain of 20.0 dB at 83 MHz. The final field strength would be determined as follows:

$$\text{CMRL} = 29.4 \text{ dBuV} + 9.2 \text{ dB} - 1.4 \text{ dB} - 20 \text{ dB/M} - 0.0 \text{ dB}$$

$$\text{CMRL} = 20.0 \text{ dBuV/M}$$

This result is well below the FCC and CSA Class A limit of 29.5 dbuV/m at 83 MHz.

For the manual mode of measurement, a table of corrected meter reading limit was used to permit immediate comparison of the meter reading to determine if the measure emission amplitude exceeded the specification limit at that specific frequency.

4 CONDUCTED EMISSION DATA/EQUIPMENT

HME ELECTRONICS

See following page(s).

Emissions Test Conditions: CONDUCTED EMISSIONS, Part 2, Paragraphs 2.1049, 2.1051 and Part 90, Paragraph 90.217

The measurements were performed at the following test location :

☐ - Test not applicable

SR-2, Shielded Room, 12' x 24' x 10', Metal Chamber

Test Equipment Used :

Model #	Manufacturer	Description	Serial #	Prop. #	Cal Date
85660B	Hewlett Packard	Spectrum Analyzer	2311A02209	407	11/01
8566B	Hewlett Packard	Spectrum Analyzer Display	2309A04682	406	11/01
HP8594E	Hewlett Packard	Spectrum Analyzer	3303A00365	430	05/01

Remarks: _____

Project Nr. S0411
HM Electronics
COM400CC

OUTPUT POWER MEASUREMENT RESULTS

LOW	MID	HIGH
468.4875 MHz	469.1375 MHz	469.8875 MHz
16.57 dBm	15.49 dBm	15.58 dBm
45.394 mW	35.400 mW	36.141 mW

Equipment Used:

HP 8594E PN: 430

*Modulation 2.5 kHz tone
16 dB higher than 50%*

TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES: 1. Low Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15: 41: 37 OCT 10. 2000

hp

REF 20.0 dBm

AT 30 dB

MKR 469.5 MHz

16.19 dBm

PEAK

LOG

10

dB/

DL

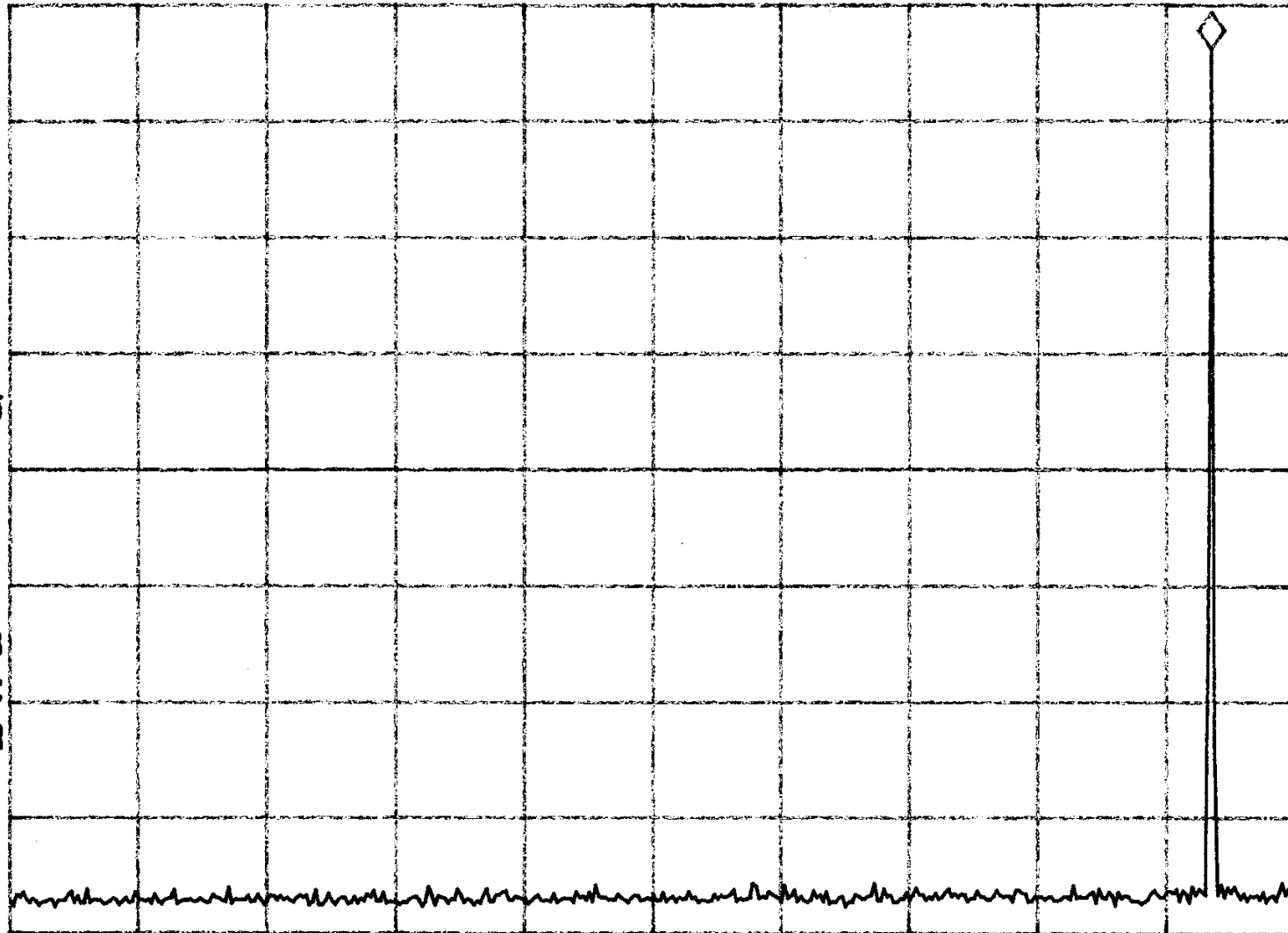
-20.0

dBm

VA SB

SC FC

CORR



START 30.0 MHz

#RES BW 100 kHz

#VBW 100 kHz

STOP 500.0 MHz

SWP 141 msec

17

NOTES:

1. Low Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15:38:17 OCT 10, 2000

MKR 937.5 MHz

REF 20.0 dBm

AT 30 dB

-40.58 dBm

PEAK

LOG

10

dB/

DL

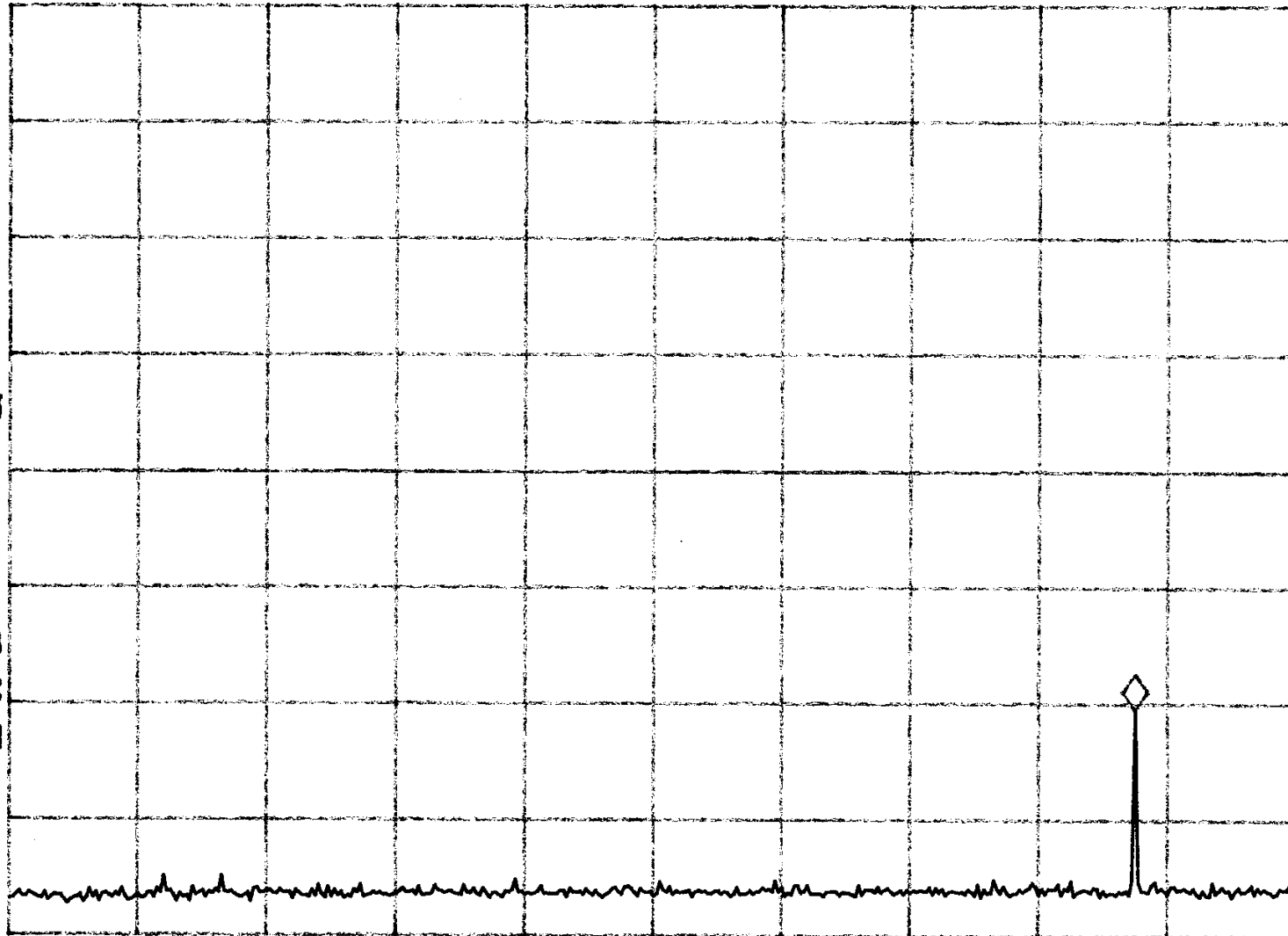
-20.0

dBm

VA SB

SC FC

CORR



START 500.0 MHz

STOP 1.0000 GHz

#RES BW 100 kHz

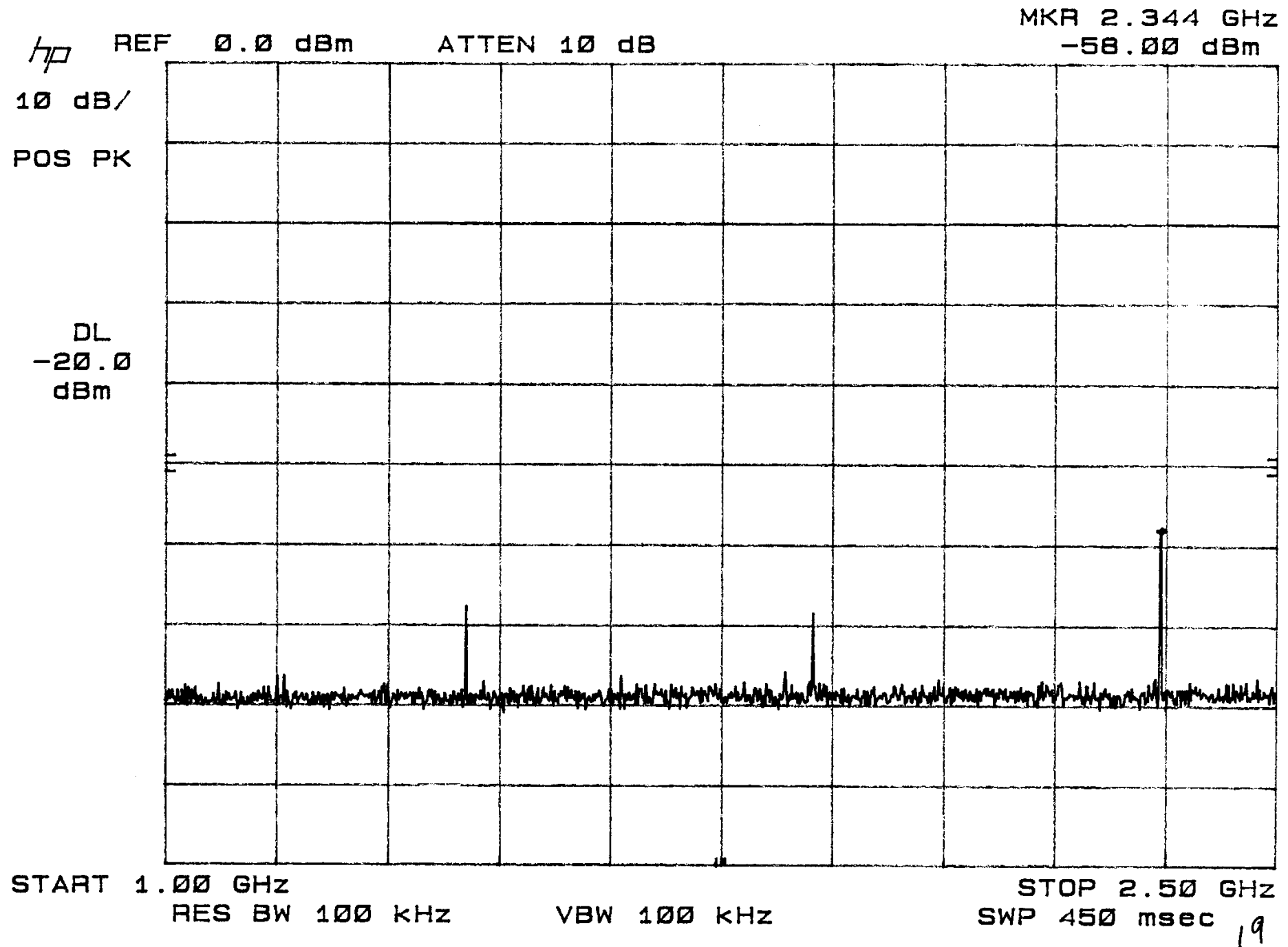
#VBW 100 kHz

SWP 150 msec

18

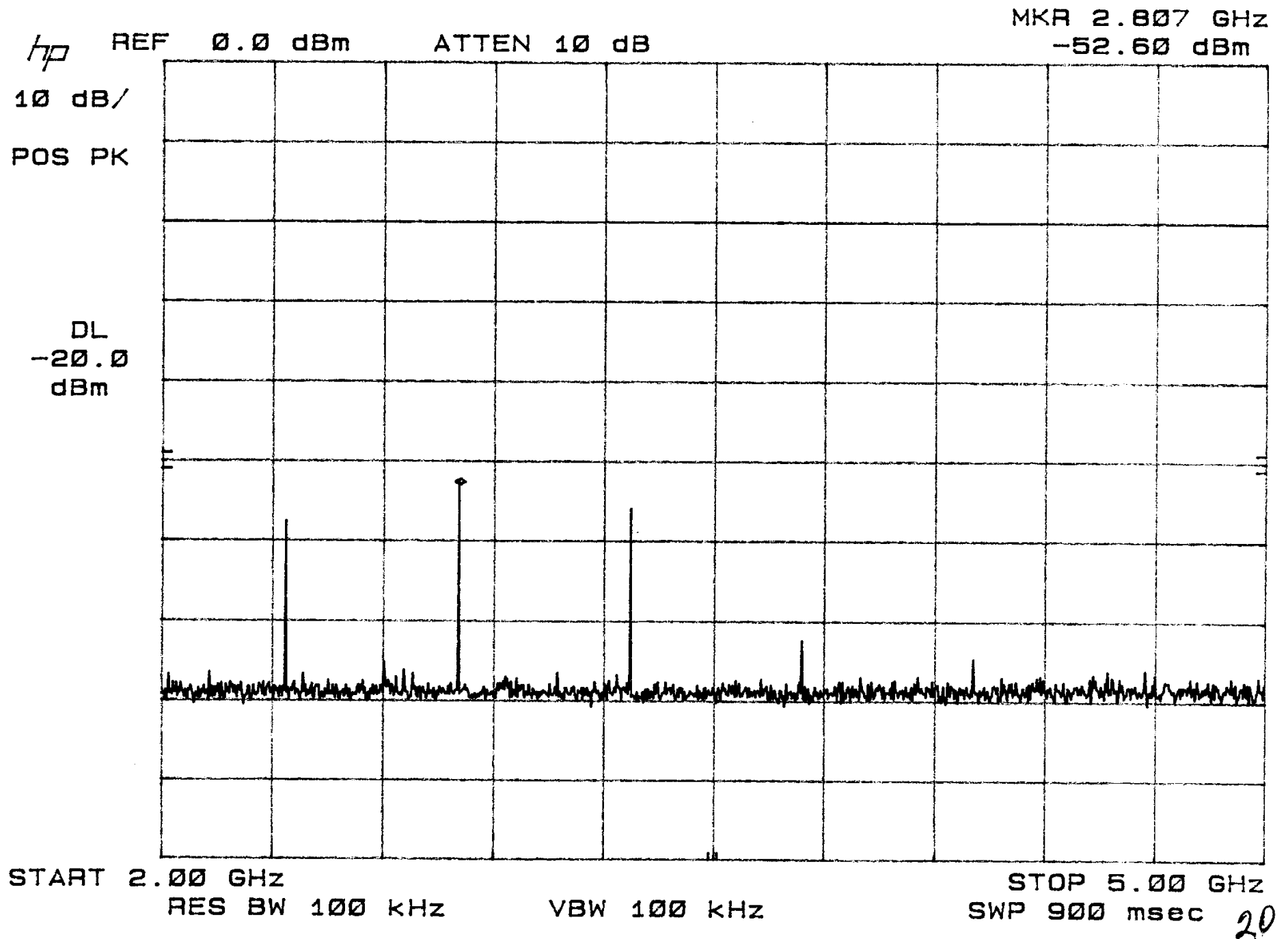
NOTES: 1. Low Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.



NOTES:

1. Low Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.



TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES: 1. Mid Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15: 13: 38 OCT 10. 2000

REF 20.0 dBm

AT 30 dB

PEAK

LOG

10

dB/

DL

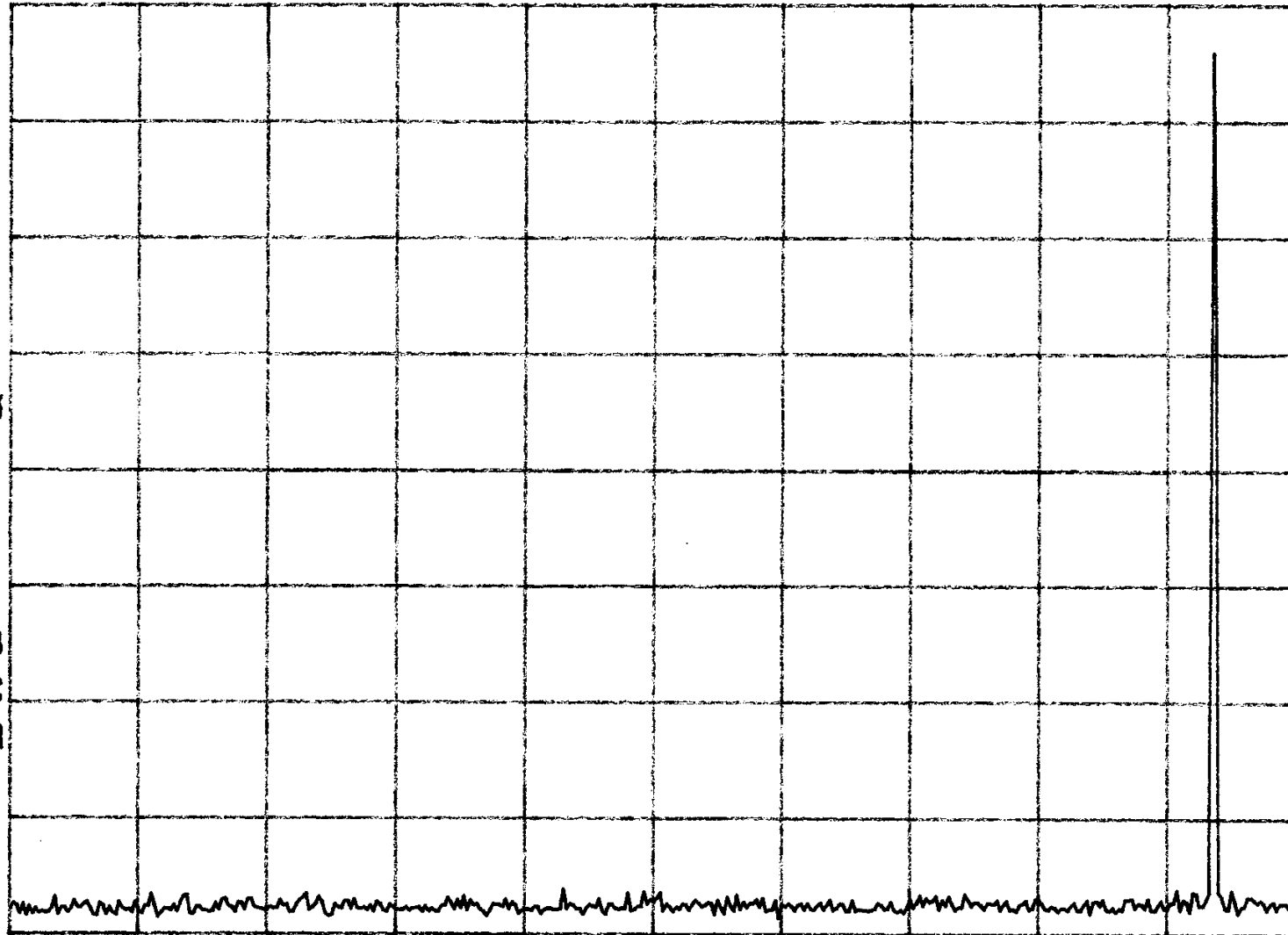
-20.0

dBm

WA SB

SC FC

CORR



START 30.0 MHz

#RES BW 100 kHz

#VBW 100 kHz

STOP 500.0 MHz

SWP 141 msec

21

NOTES:

1. Mid Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15: 17: 14 OCT 10. 2000

hp

REF 20.0 dBm

AT 30 dB

MKR 940.0 MHz

-41.10 dBm

PEAK

LOG

10

dB/

DL

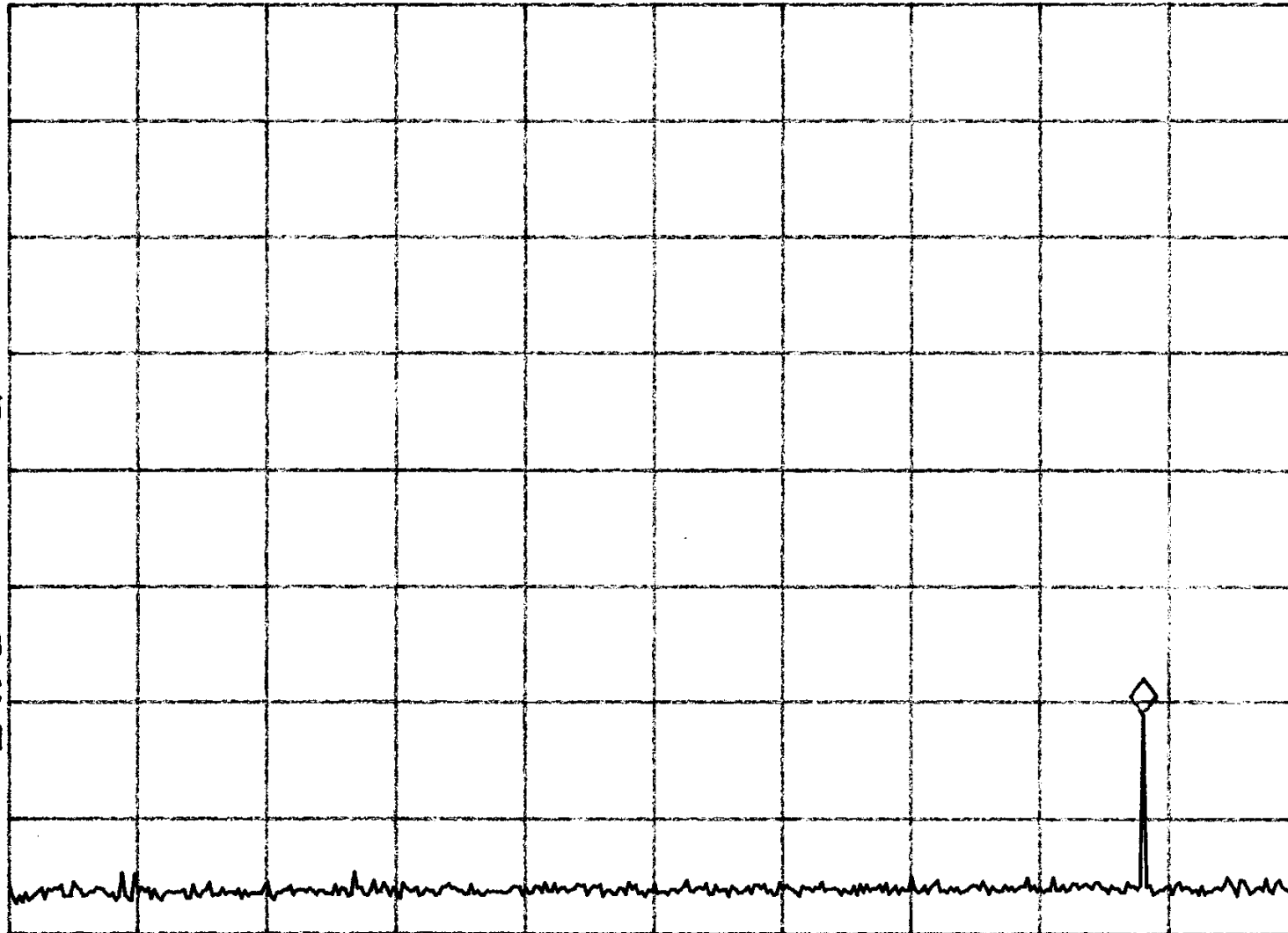
-20.0

dBm

VA SB

SC FC

CORR



START 500.0 MHz

#RES BW 100 KHz

STOP 1.0000 GHz

#VBW 100 KHz

SWP 150 msec

22

TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES: 1. Mid Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

MKR 2.349 GHz

-62.00 dBm

hp

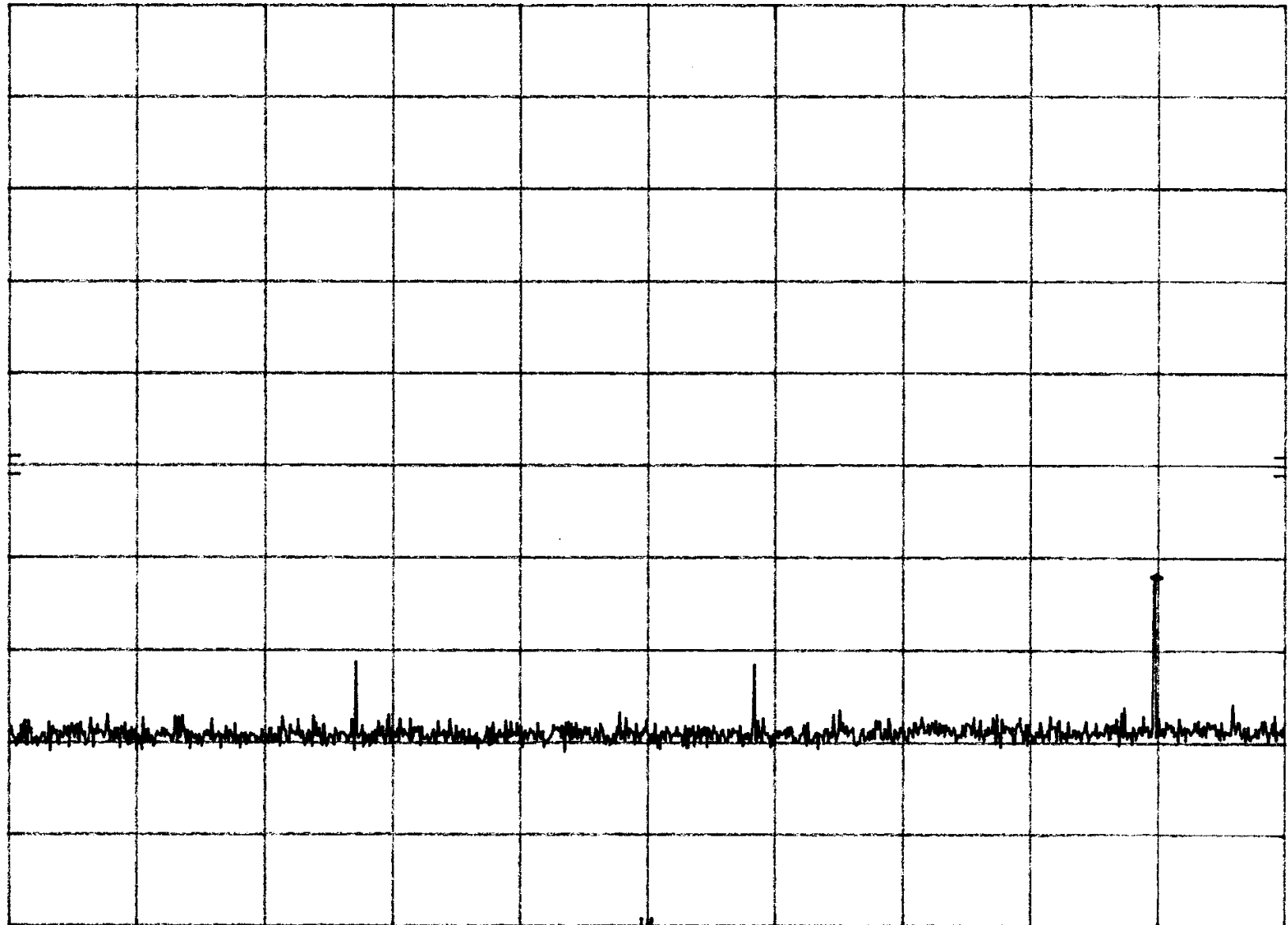
REF 0.0 dBm

ATTEN 10 dB

10 dB/

POS PK

DL
-20.0
dBm



START 1.00 GHz

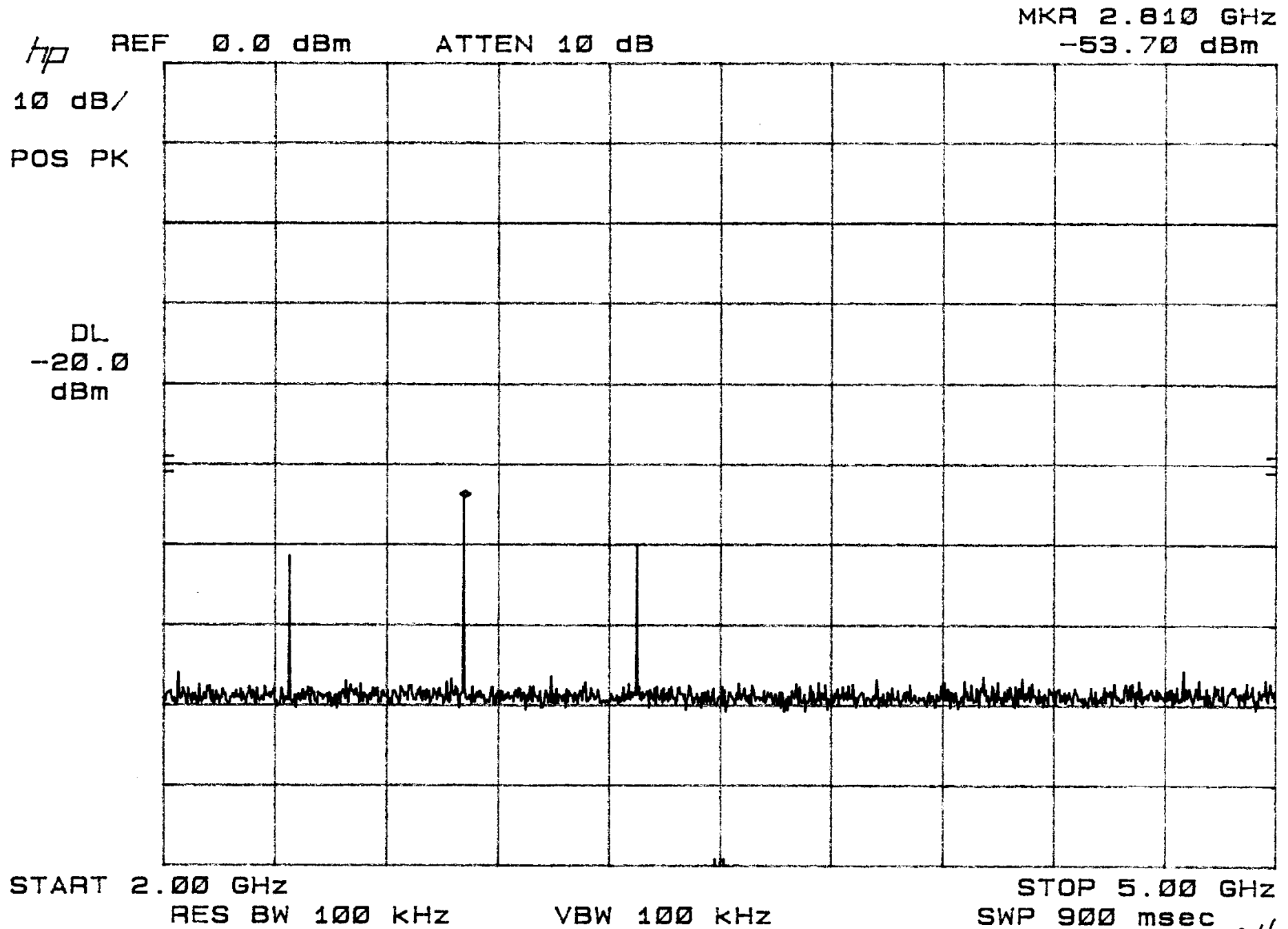
RES BW 100 kHz

VBW 100 kHz

STOP 2.50 GHz

SWP 450 msec 23

TEST: Conducted Spurious, Part 2, Para. 2.1051
NOTES: 1. Mid Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.



NOTES:

1. High Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15: 46: 22 OCT 10. 2000

hp

REF 20.0 dBm

AT 30 dB

MKA 469.5 MHz

16.21 dBm

PEAK

LOG

10

dB/

DL

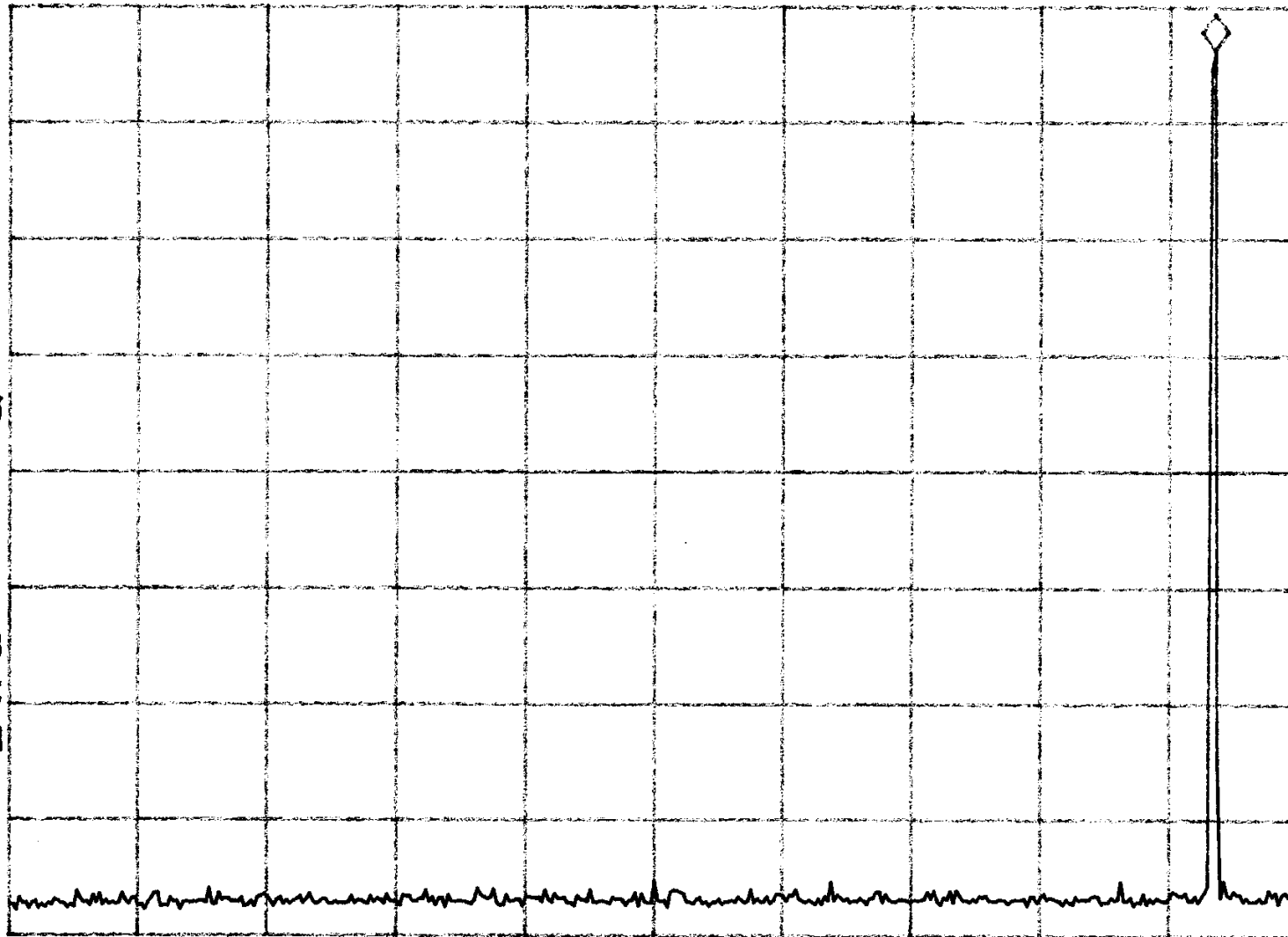
-20.0

dBm

VA SB

SC FC

CORR



START 30.0 MHz

#RES BW 100 KHz

#VBW 100 KHz

STOP 500.0 MHz

SWP 141 msec

25

TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES:

1. High Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

15: 49: 11 OCT 10, 2000

MKR 938.7 MHz

REF 20.0 dBm

AT 30 dB

-40.80 dBm

PEAK

LOG

10

dB/

DL

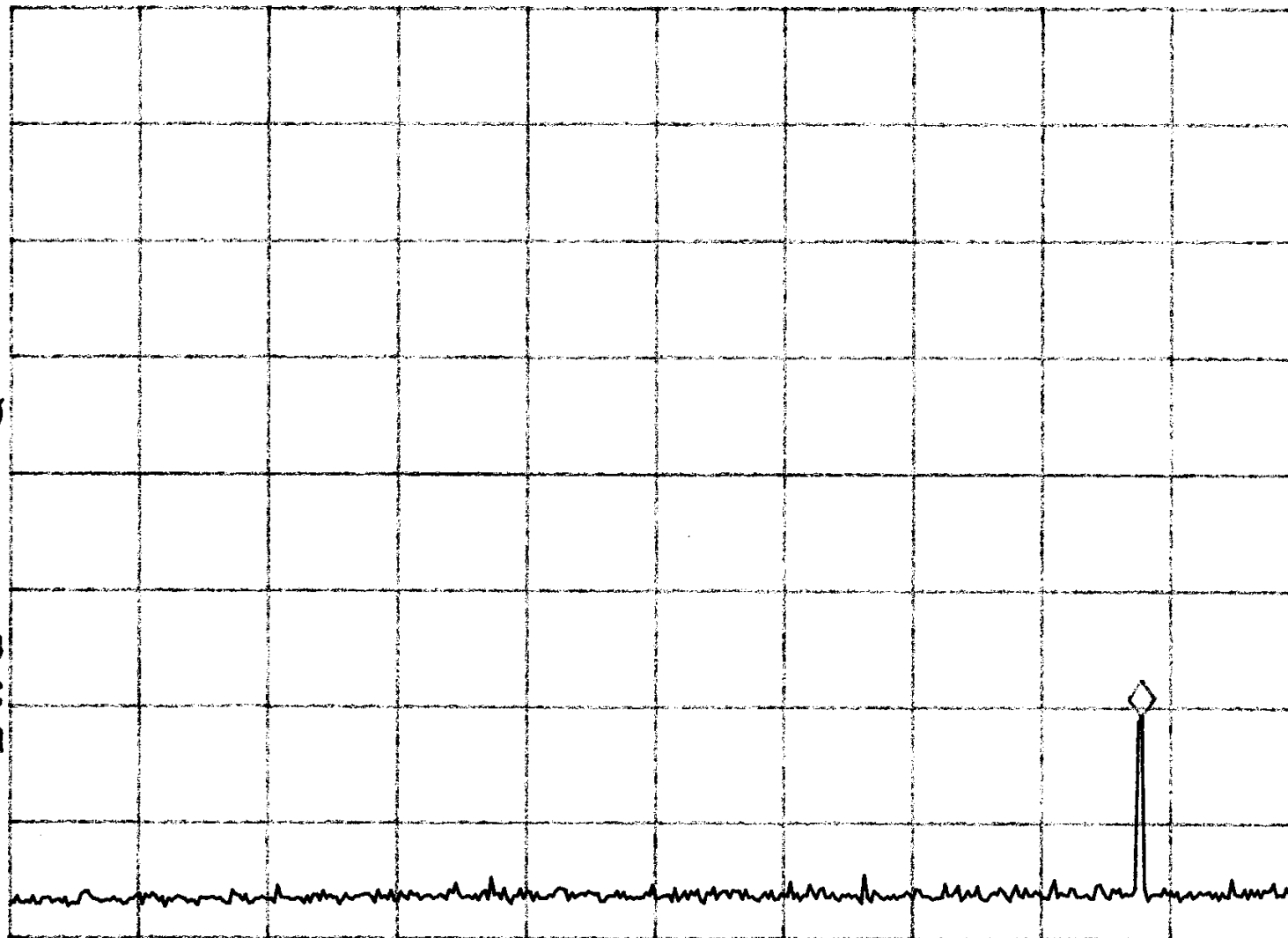
-20.0

dBm

VA SB

SC FC

CORR



START 500.0 MHz

#RES BW 100 KHz

#VBW 100 KHz

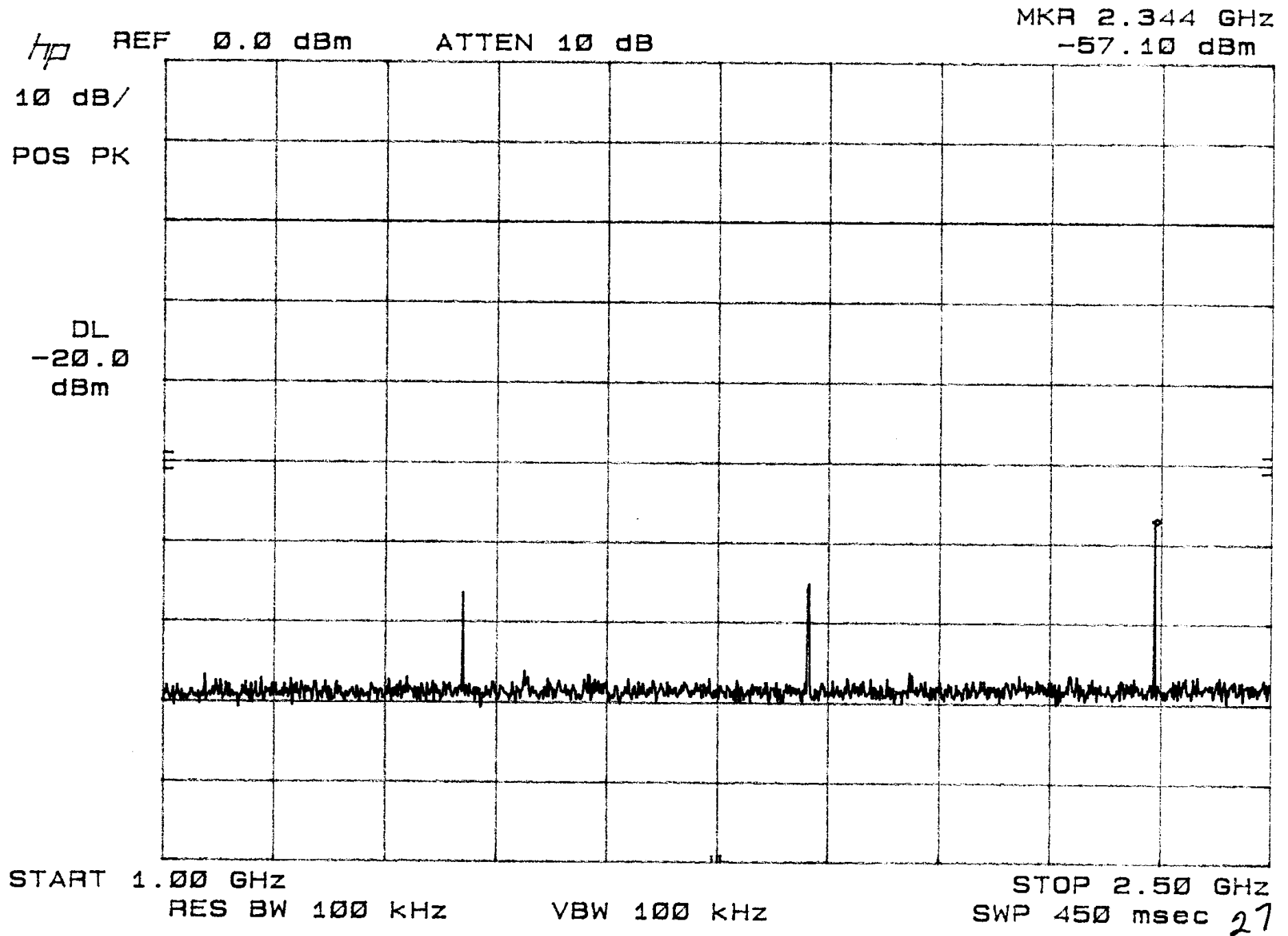
STOP 1.0000 GHz

SWP 150 msec

TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES: 1. High Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.



TEST: Conducted Spurious, Part 2, Para. 2.1051

NOTES: 1. High Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

MKR 2.807 GHz

-51.40 dBm

hp

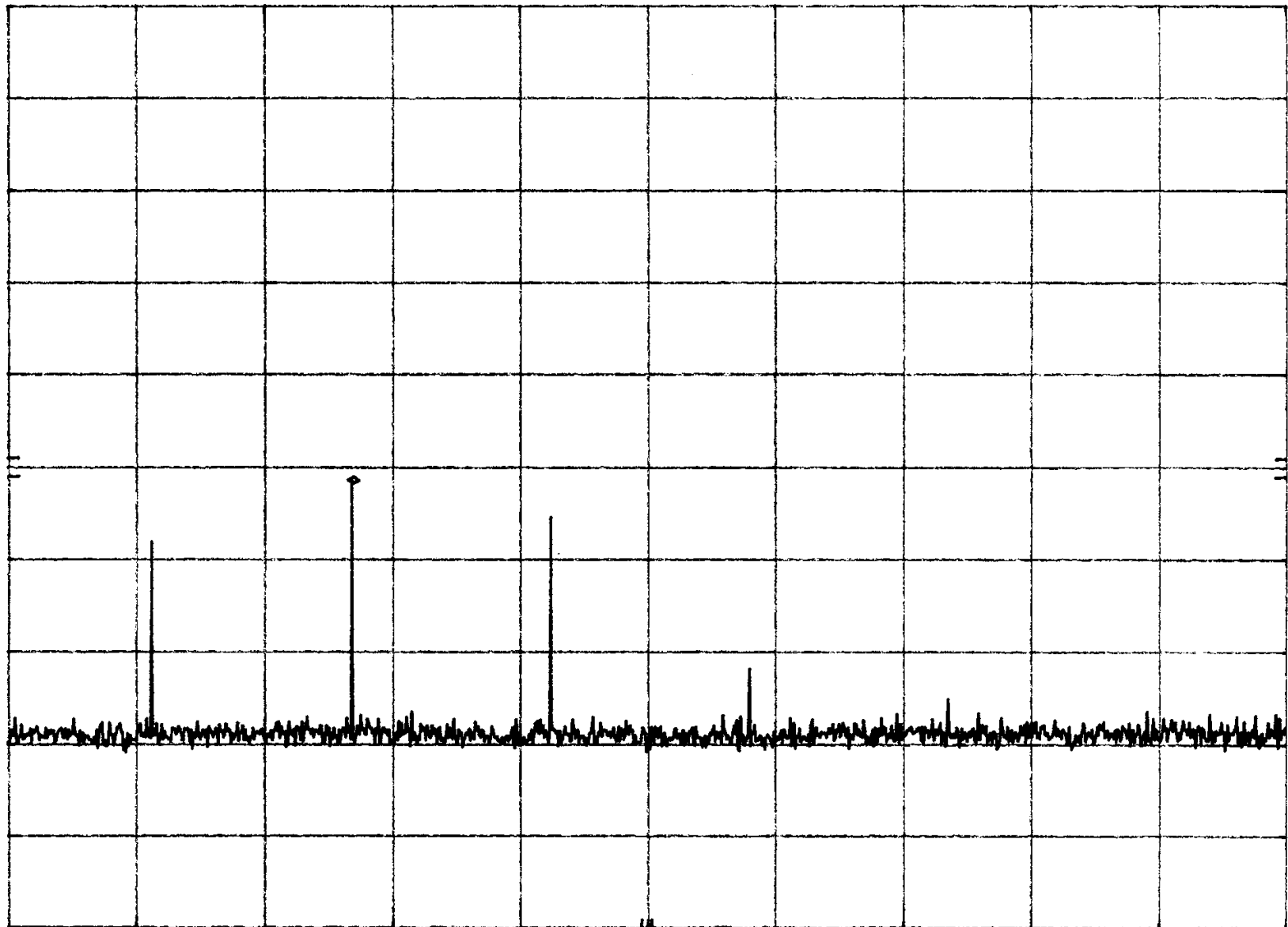
REF 0.0 dBm

ATTEN 10 dB

10 dB/

POS PK

DL
-20.0
dBm



START 2.00 GHz

RES BW 100 kHz

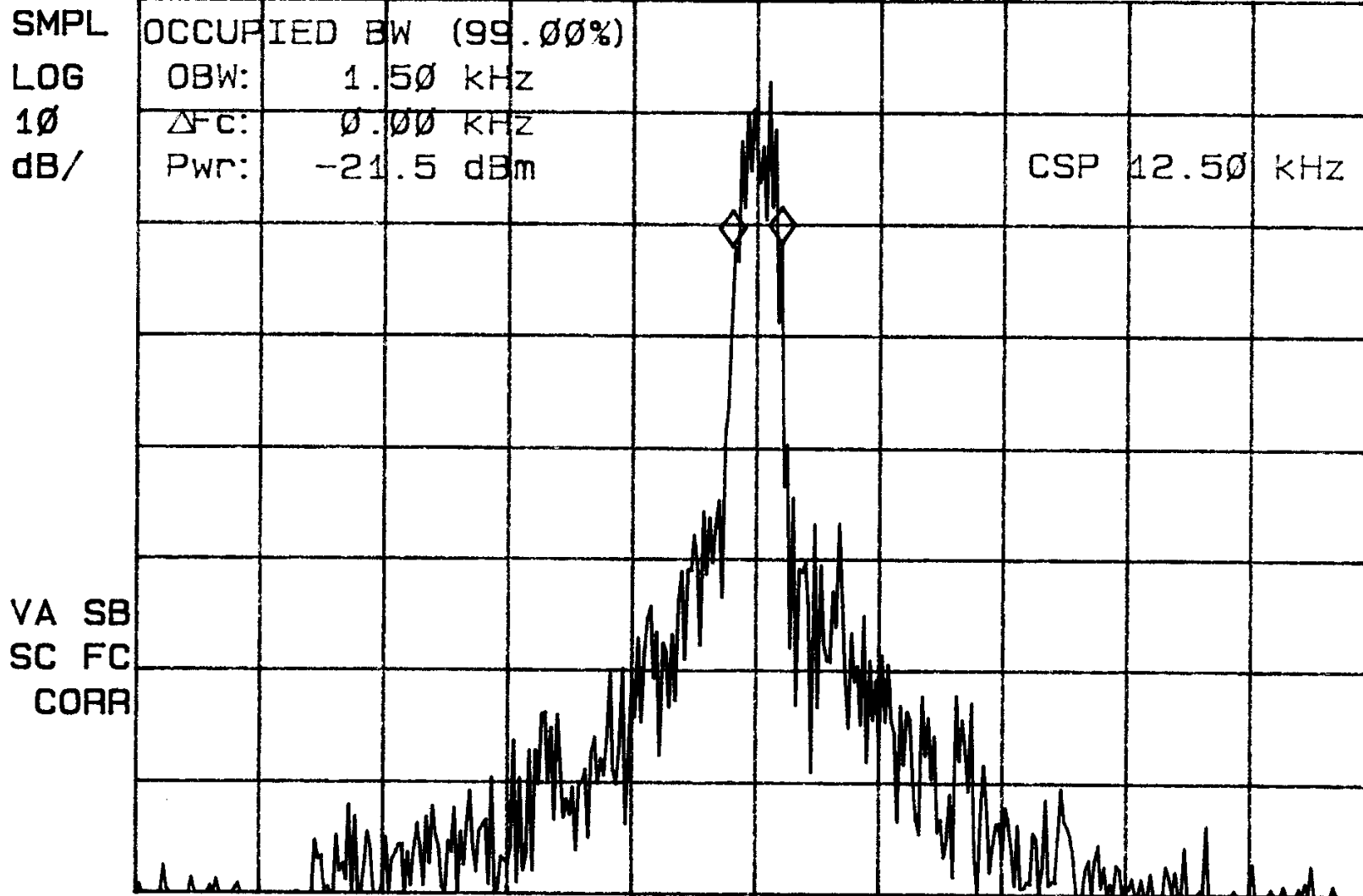
VBW 100 kHz

STOP 5.00 GHz

SWP 900 msec 28

13: 42: 12 OCT 10, 2000
hp

REF -20.0 dBm AT 10 dB



CENTER 468.48750 MHz

#RES BW 100 Hz

#VBW 1 kHz

SPAN 37.50 kHz

SWP 11.3 sec

14: 14: 07 OCT 10, 2000
hp

REF -20.0 dBm AT 10 dB

SMPL OCCUPIED BW (99.00%)

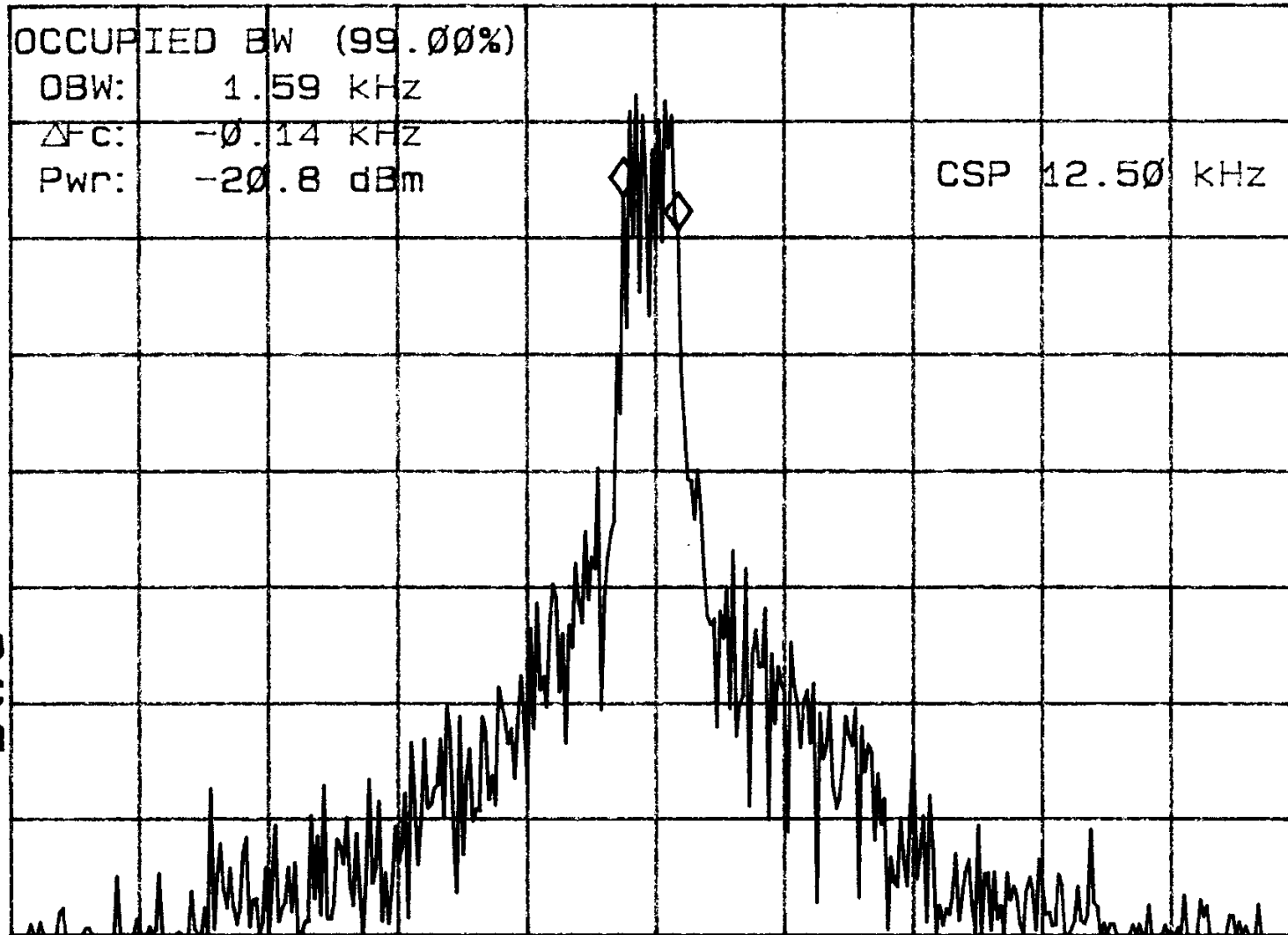
LOG OBW: 1.59 kHz

10 ΔFc: -0.14 kHz

dB/ Pwr: -20.8 dBm

CSP 12.50 kHz

WA SB
SC FC
CORR



CENTER 469.13750 MHz

#RES BW 100 Hz

#VBW 1 kHz

SPAN 37.50 kHz

SWP 11.3 sec

30

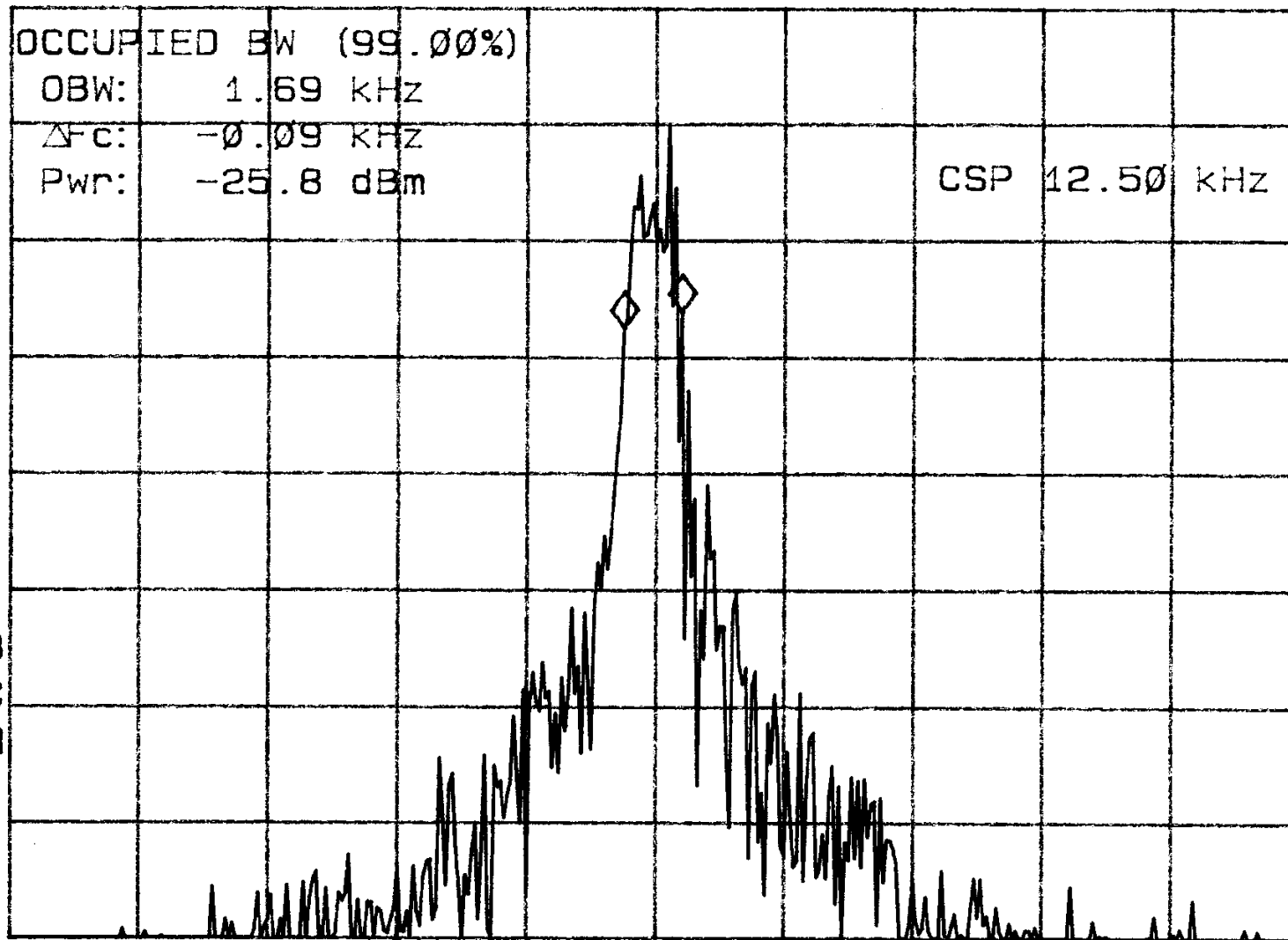
14: 21: 07 OCT 10. 2000
~~hp~~

REF -20.0 dBm AT 10 dB

SMPL OCCUPIED BW (99.00%)
LOG OBW: 1.69 kHz
10 Δf_c : -0.09 kHz
dB/ Pwr: -25.8 dBm

CSP 12.50 kHz

WA SB
SC FC
CORR



CENTER 469.88750 MHz

SPAN 37.50 kHz

#RES BW 100 Hz

#VBW 1 kHz

SWP 11.3 sec

31

- NOTES:
1. Low Channel
 2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

16: 22: 18 OCT 10, 2000

hp

REF 20.0 dBm

AT 30 dB

MKR Δ -5.63 KHz

-48.49 dB

PEAK

LOG

10

dB/

DL

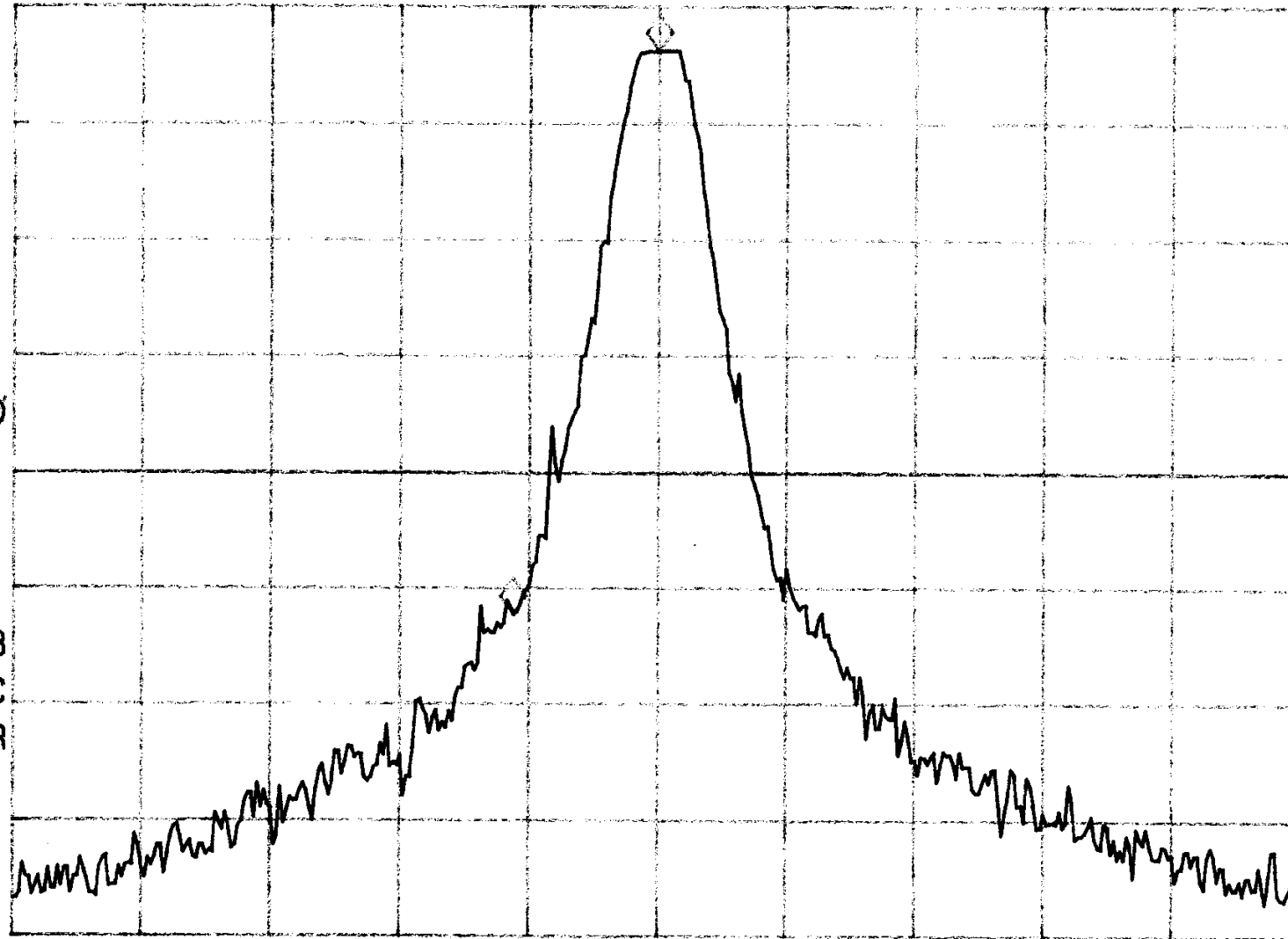
-20.0

dBm

VA SB

SC FC

CORR



CENTER 468.48750 MHz

RES BW 1.0 KHz

VBW 1 KHz

SPAN 50.00 KHz

SWP 300 msec

NOTES:

1. Low Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

16: 18: 10 OCT 10, 2000

hp

REF 20.0 dBm

AT 30 dB

MKR Δ 5.63 kHz

-47.67 dB

PEAK

LOG

10

dB/

DL

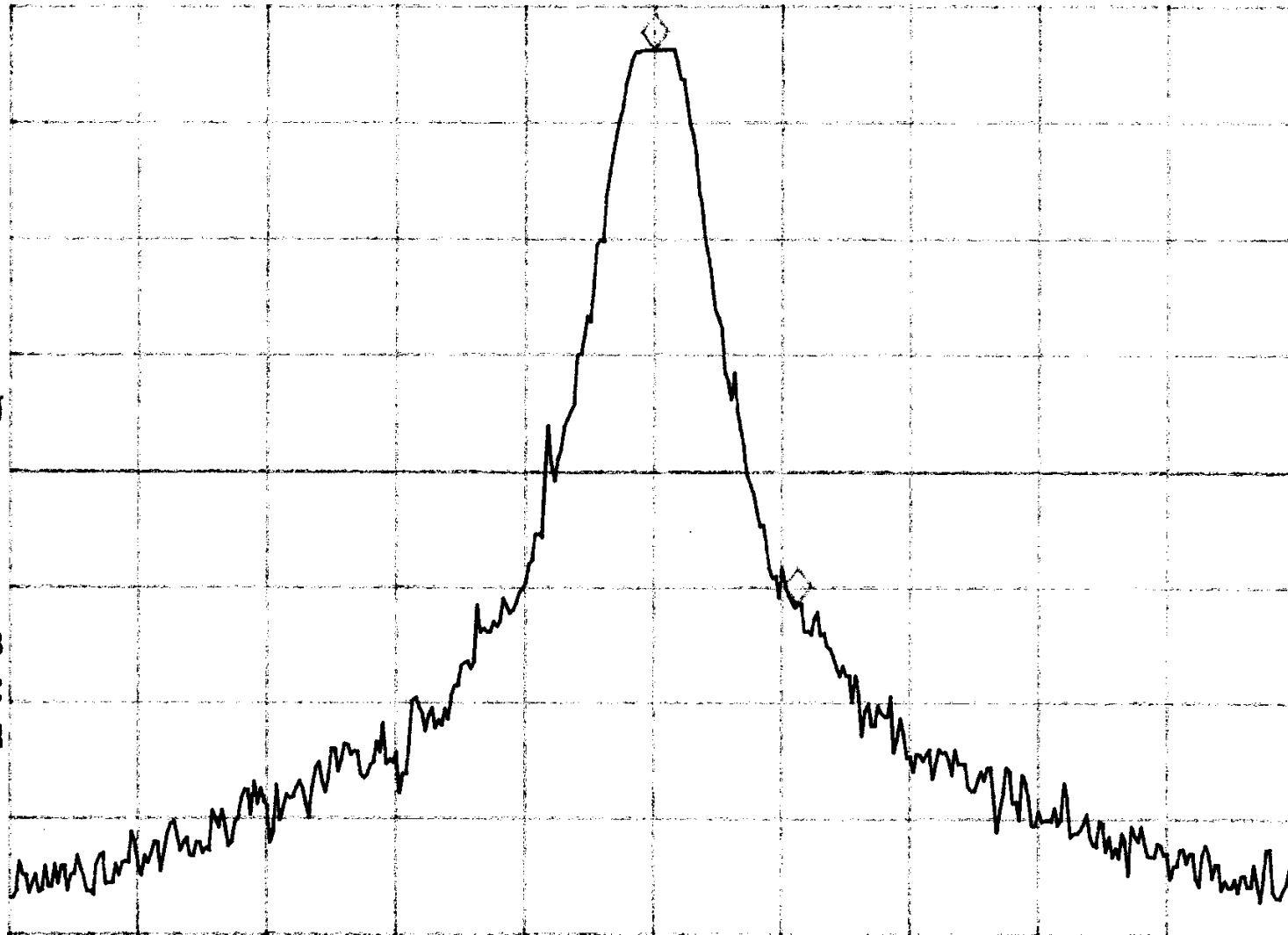
-20.0

dBm

VA SB

SC FC

CORR



CENTER 468.48750 MHz

RES BW 1.0 kHz

VBW 1 kHz

SPAN 50.00 kHz

SWP 300 msec

TEST: Exemption from standard emission mask plot, FCC Part 90, Paragraph 90.217

NOTES:

1. Mid Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

16: 13: 46 OCT 10, 2000

MKR Δ -5.63 kHz

REF 20.0 dBm

AT 30 dB

-45.78 dB

PEAK

LOG

10

dB/

DL

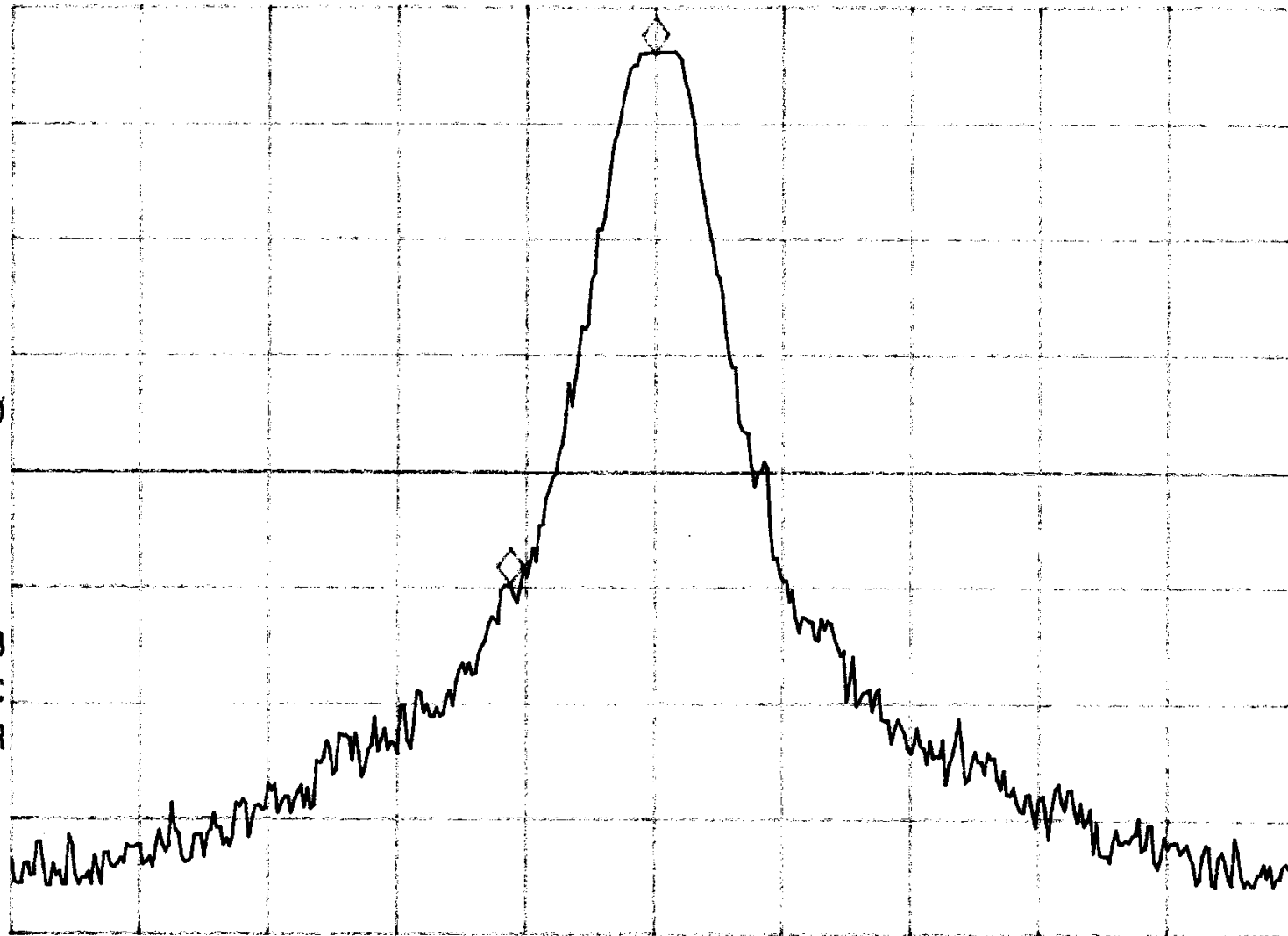
-20.0

dBm

VA SB

SC FC

CORR



CENTER 469.13750 MHz

SPAN 50.00 kHz

RES BW 1.0 kHz

VBW 1 kHz

SWP 300 msec

34

TEST: Exemption from standard emission mask plot, FCC Part 90, Paragraph 90.217

NOTES:

1. Mid Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

16:11:12 OCT 10, 2000

MKR Δ 5.63 KHz

REF 20.0 dBm

AT 30 dB

-49.91 dB

PEAK

LOG

10

dB/

DL

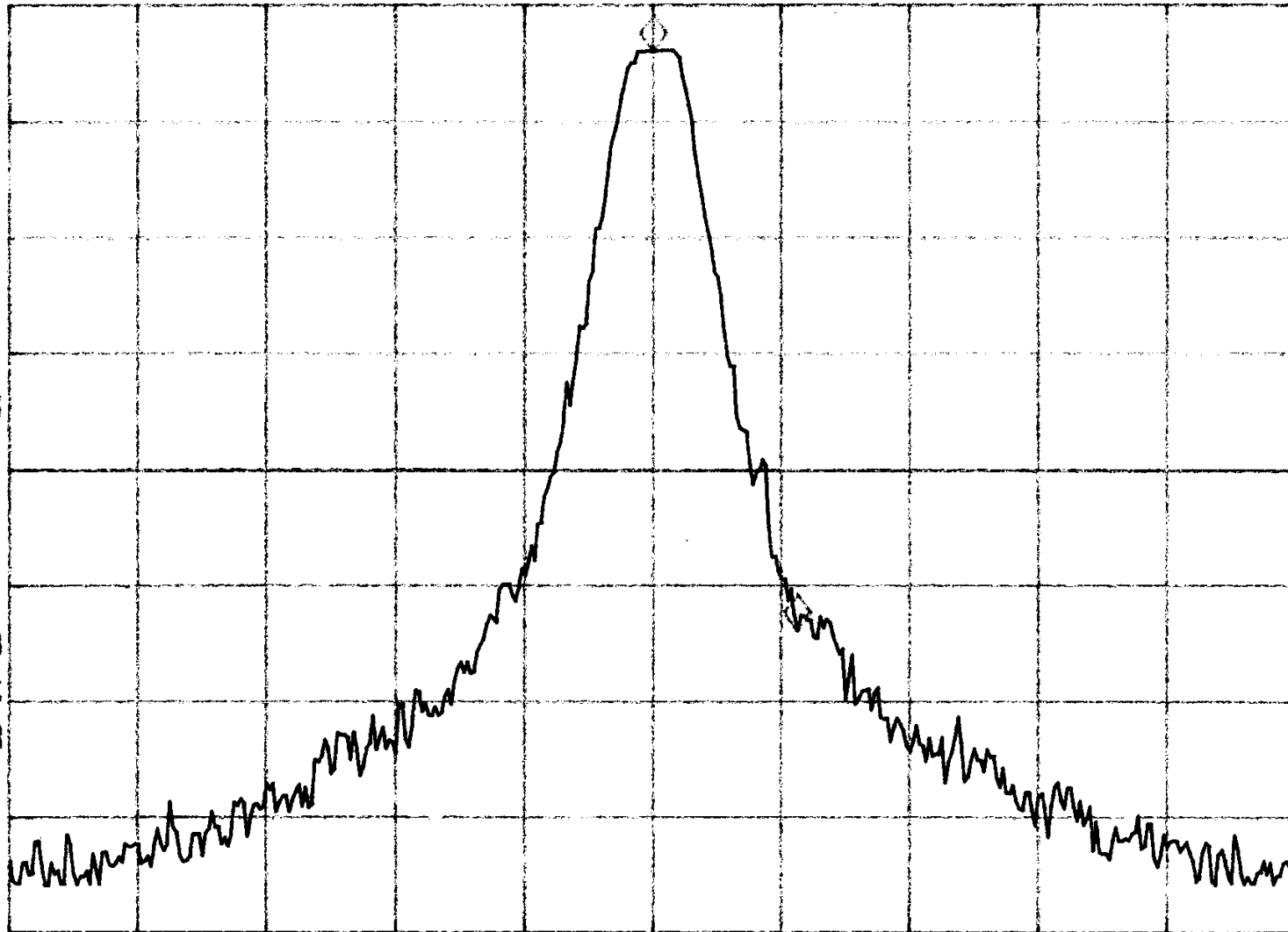
-20.0

dBm

VA SB

SC FC

CORR



CENTER 469.13750 MHz

SPAN 50.00 KHz

RES BW 1.0 KHz

VBW 1 KHz

SWP 300 msec

35

NOTES:

1. High Channel
2. Modulation 2.5 kHz tone, 16 dB higher than 50%.

16:05:38 OCT 10, 2000

hp

REF 20.0 dBm

AT 30 dB

MKR Δ 5.63 kHz

-50.93 dB

PEAK

LOG

10

dB/

DL

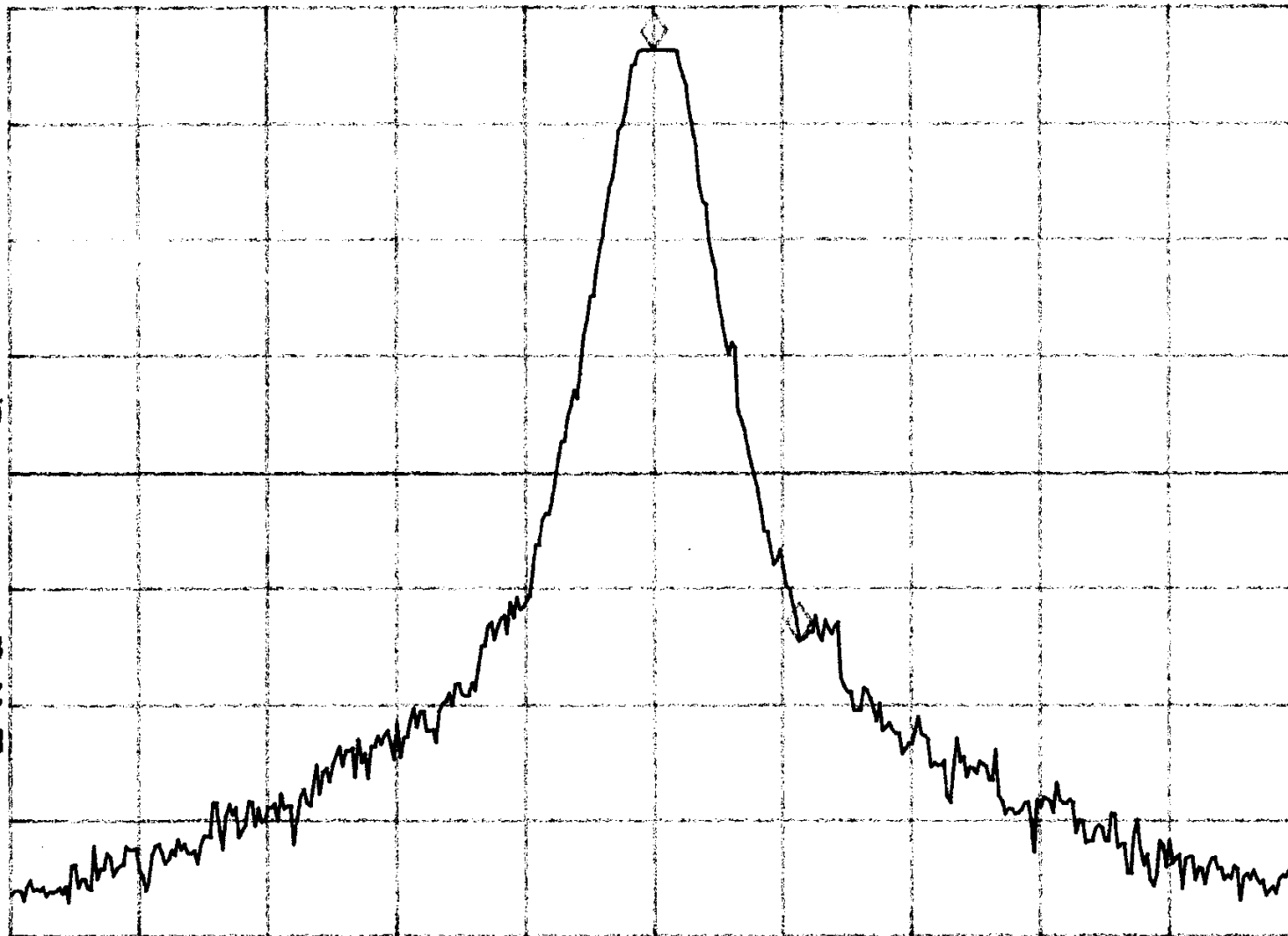
-20.0

dBm

VA SB

SC FC

CORR



CENTER 468.48738 MHz

RES BW 1.0 kHz

SPAN 50.00 kHz

SWP 300 msec

VBW 1 kHz

TEST: Exemption from standard emission mask plot, FCC Part 90, Paragraph 90.217

NOTES: 1. High Channel

2. Modulation 2.5 kHz tone, 16 dB higher than 50%. TEST: Conducted Spurious, Part 2, Para. 2.1051

16:03:13 OCT 10. 2000

hp

REF 20.0 dBm

AT 30 dB

MKR Δ -5.63 kHz

-47.55 dB

PEAK

LOG

10

dB/

DL

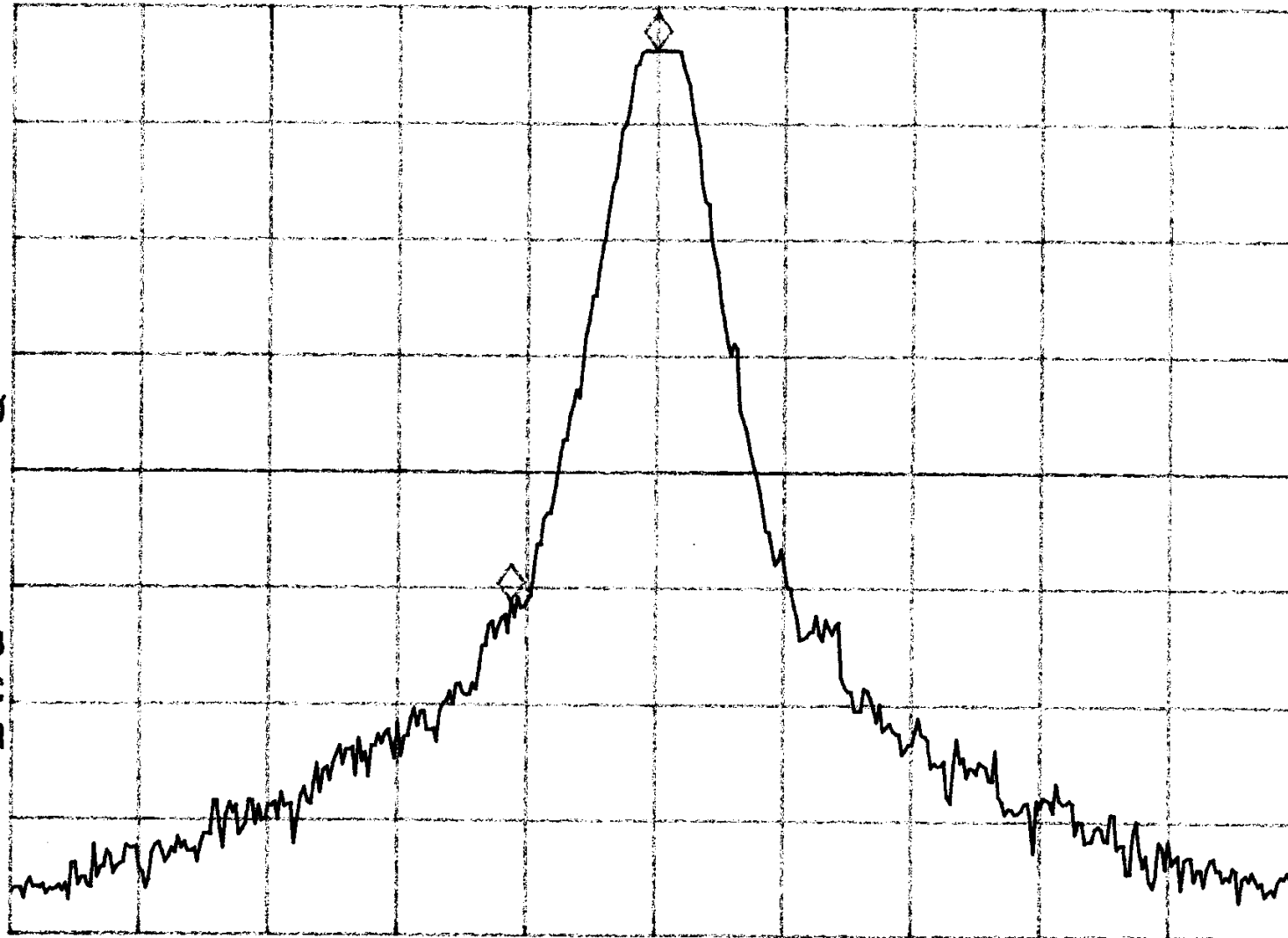
-20.0

dBm

VA SB

SC FC

CORR



CENTER 468.48738 MHz

RES BW 1.0 kHz

VBW 1 kHz

SPAN 50.00 kHz

SWP 300 msec

37

Emissions Test Conditions: FREQUENCY STABILITY (Tests performed by HM Electronics)
DATA/EQUIPMENT

9 Nov, 00

Information regarding testing of COM400CC at HM Electronics.

The following tests on the COM400CC were performed on the dates noted:

1. Frequency Stability vs. Temperature 12 October 2000 and 13 Oct 2000
2. Audio Frequency Response 13 October 2000
3. Modulation Limiting 13 October 2000

The tests were performed by: Eligio Rollo, Technician, HME Engineering Dept.

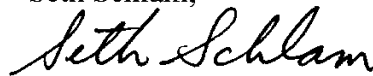
The tests were supervised by: Seth Schlam, Engineer, HME Engineering Services Dept.

Equipment used for these tests, and calibration data for the equipment is as follows:

1. Temperature Chamber: Environtronics Model ST1, S/N 079010030
Performance Verification: July 2000 by HM Electronics
next due: July 2001
Note: Temperature Monitoring verified by Fluke Digital
Multimeter with Thermocouple Module.
2. Fluke Multimeter: Fluke model D800, S/N 3085032
Calibration Date: 4/21/2000
next due: 4/21/2001
Calibration by: Excalibur Engineering
3198-C Airport Loop Drive
Costa Mesa Ca. 92626
3. Fluke Thermocouple Converter: Fluke model 80TK, S/N AA00091737
Calibration Date: August 3, 2000
next due: August 3, 2002
Calibration by: Excalibur Engineering
4. Hewlett Packard RF Communications Test Set: Model HP8920A, S/N 3141A00596
Calibration Date: November 18, 1998
next due: November 18, 2000
Calibration by: Certified Metrology Services Inc.
1425 Russ Blvd.
San Diego, Ca. 92101

The above information is true and correct.

Seth Schlam,



HM Electronics Engineering Services

COM400CC Frequency Stability vs. Temperature Test Data

Requirement: 47 CFR 2.1055

Test Method: EIA – TIA – 603 (93) para 2.2.2

The COM400CC was temperature soaked at –30 degrees C overnight prior to taking the first test reading. For each step in temperature, the unit was temp soaked for ½ hour prior to taking the test reading. The readings were taken while the unit remained in the environmental chamber. Data is shown in table 1 below. A graph of the data is shown in Figure 1.

Temp (Deg. C)	ACF (MHz)	MCF (MHz)	PPM error	Time
- 30	469.1375	469.1324011	10.86	12:00 PM
- 20	469.1375	469.135488	4.28	12:30 PM
- 10	469.1375	469.137076	.90	1:00 PM
0	469.1375	469.137981	1.02	1:30 PM
+ 10	469.1375	469.138022	1.11	2:00 PM
+ 20	469.1375	469.138022	1.11	2:30 PM
+ 30	469.1375	469.137729	.48	3:00 PM
+ 40	469.1375	469.137412	.18	3:30 PM
+ 50	469.1375	469.137251	.53	4:00 PM
+ 60	469.1375	469.136354	2.44	8:00 AM

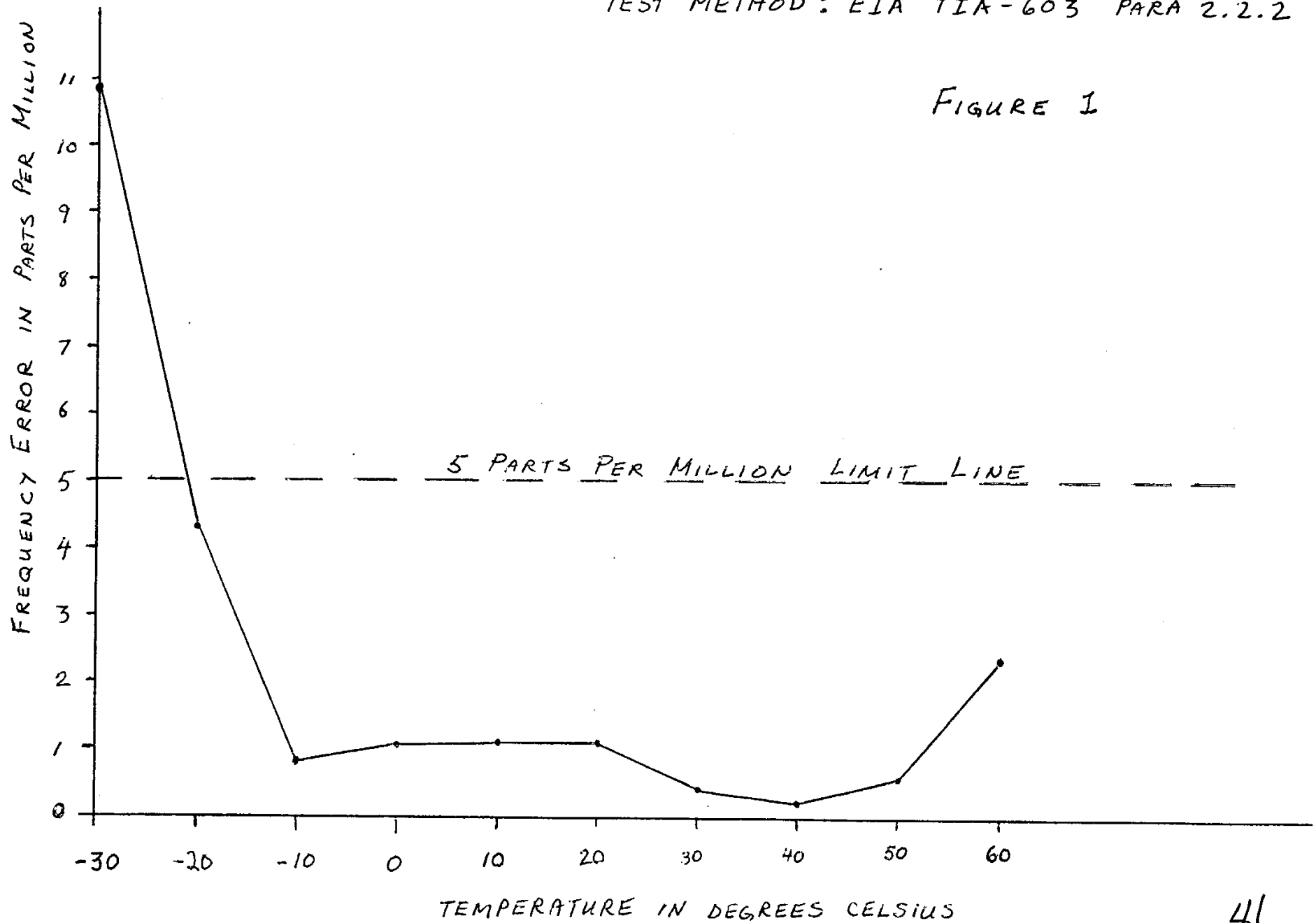
ACF = Assigned Center Frequency
MCF = Measured Center Frequency
PPM = Parts Per Million

Table 1.

REQUIREMENT: 47CFR 2.1055 FREQUENCY STABILITY

TEST METHOD: EIA TIA-603 PARA 2.2.2

FIGURE 1



COM400CC - FREQUENCY STABILITY VS. TEMPERATURE

COM400CC Audio Frequency Response

Requirement: 47 CFR 2.1047 (a)

Test Method: EIA-TIA-603 (93) para. 2.2.6

Note: Due to subaudible tones used for control (CTCSS continuous tone controlled squelch system) the COM400CC has a low end frequency of 300 Hz for audio. The high end is approximately 3000 Hz. The data readings below were taken from 3000 to 5000 Hz audio input, as shown in table 2 below. This data is graphed in Figure 2 , against the 6 dB per Octave line.

Frequency (Hz)	FM Deviation (Hz)	Audio Freq Response (dB)
300	120	-9.54
400	160	-7.04
500	197	-5.23
600	230	-3.89
700	260	-2.82
800	295	-1.72
900	327	-0.83
1000 * Ref Lvl	360	0.0
1100	395	+0.80
1200	430	+1.54
1300	465	+2.22
1400	500	+2.85
1500	535	+3.44
1600	571	+4.00
1700	607	+4.53
1800	644	+5.05
1900	678	+5.49
2000	713	+5.93
2100	749	+6.36
2200	781	+6.72
2300	812	+7.06
2400	842	+7.38
2500	870	+7.66
2600	895	+7.91
2700	917	+8.12
2800	934	+8.28

Table 2.

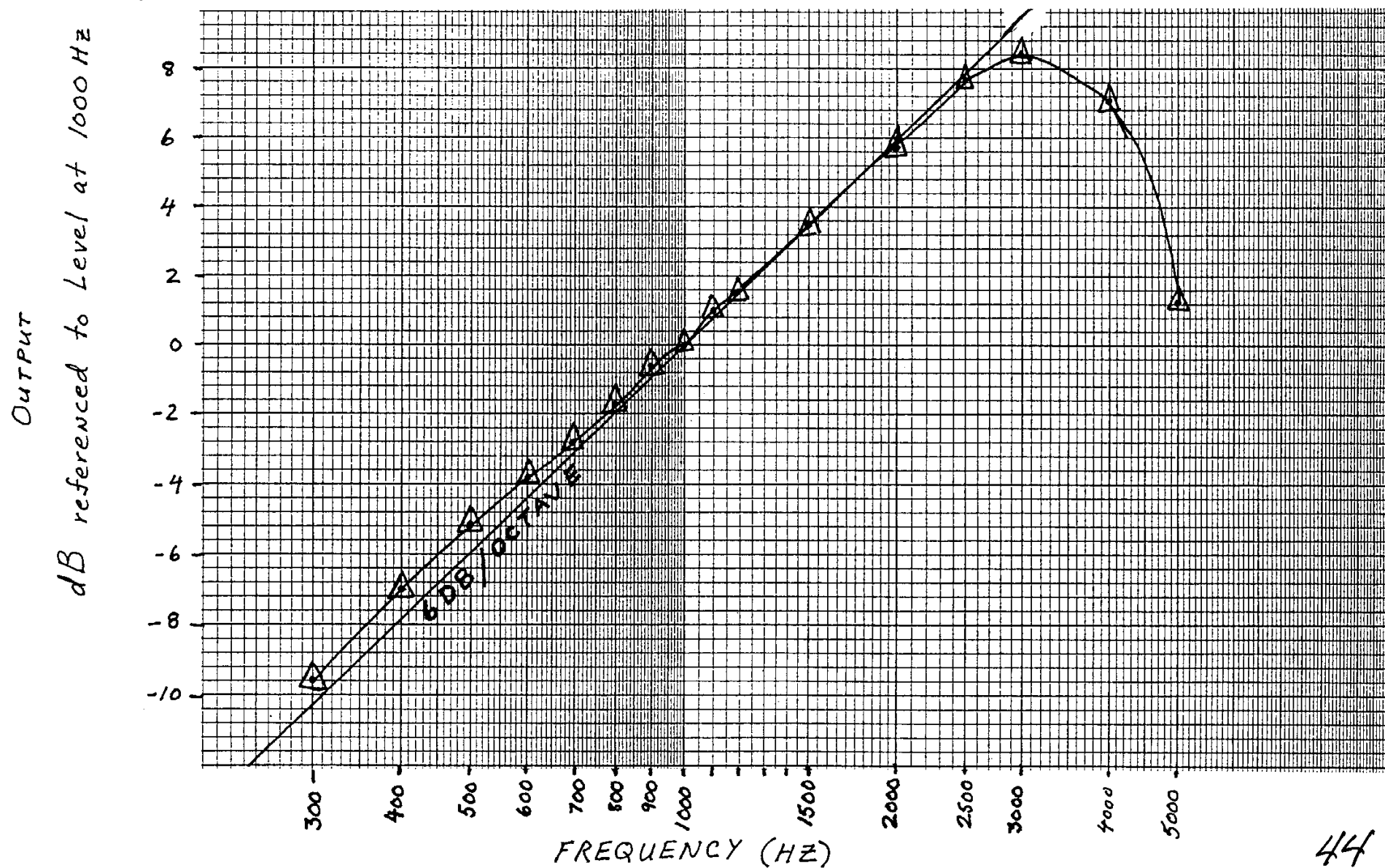
Table 2. Audio Frequency Response for COM400CC (continued)

Frequency (Hz)	FM Deviation (Hz)	Audio Freq Response (dB)
2900	950	+8.42
3000	960	+8.51
3100	970	+8.60
3200	970	+8.60
3300	970	+8.60
3400	960	+8.51
3500	946	+8.39
3600	928	+8.22
3700	908	+8.03
3800	881	+7.77
3900	851	+7.47
4000	818	+7.12
4100	782	+6.73
4200	742	+6.28
4300	701	+5.78
4400	661	+5.27
4500	619	+4.70
4600	577	+4.09
4700	535	+3.44
4800	494	+2.74
4900	455	+2.03
5000	418	+1.29

Requirement: CFR 2.1047(a)

COM 400CC

Test Method EIA-TIA-603 para. 2.2.6 AUDIO FREQUENCY RESPONSE 300 TO 5000 Hz



COM400CC Modulation Limiting

Requirement: 47 CFR 2.1047 (b)

Test Method: EIA – TIA – 603 (93) para. 2.2.3

Test data for the Modulation Limiting test is shown in table 3 for Positive Peak Detection and in table 4 for Negative Peak Detection. Figures 3 and 4 show the graphs of the data.

Table 3 Max FM Deviation (+ Peak Detector) vs. Audio Input Frequency

Audio Freq (Hz)	Max. FM Deviation (Hz)		Audio Freq (Hz)	Max. FM Deviation (Hz)
300	1780		2700	3340
400	2480		2800	3430
500	2980		2900	3340
600	3290		3000	3400
700	3520		3100	3340
800	3660		3200	3280
900	3720		3300	3280
1000	3720		3400	3080
1100	3680		3500	3130
1200	3630		3600	3000
1300	3580		3700	2770
1400	3560		3800	2650
1500	3540		3900	2610
1600	3500		4000	2370
1700	3460		4100	2200
1800	3420		4200	2130
1900	3390		4300	2070
2000	3370		4400	1980
2100	3230		4500	1760
2200	3280		4600	1570
2300	3300		4700	1550
2400	3300		4800	1560
2500	3300		4900	1560
2600	3410		5000	1240

Table 4 Max FM Deviation (- Peak Detector) vs. Audio Input Frequency

Audio Freq (Hz)	Max. FM Deviation (Hz)		Audio Freq (Hz)	Max. FM Deviation (Hz)
300	1730		2700	3420
400	2440		2800	3390
500	2890		2900	3460
600	3200		3000	3360
700	3410		3100	3400
800	3560		3200	3330
900	3630		3300	3320
1000	3660		3400	3310
1100	3640		3500	3140
1200	3610		3600	3140
1300	3570		3700	3060
1400	3510		3800	3060
1500	3460		3900	2730
1600	3420		4000	2720
1700	3370		4100	2700
1800	3340		4200	2640
1900	3330		4300	2300
2000	3300		4400	2360
2100	3330		4500	2180
2200	3330		4600	2060
2300	3370		4700	2060
2400	3390		4800	1780
2500	3420		4900	1820
2600	3500		5000	1770

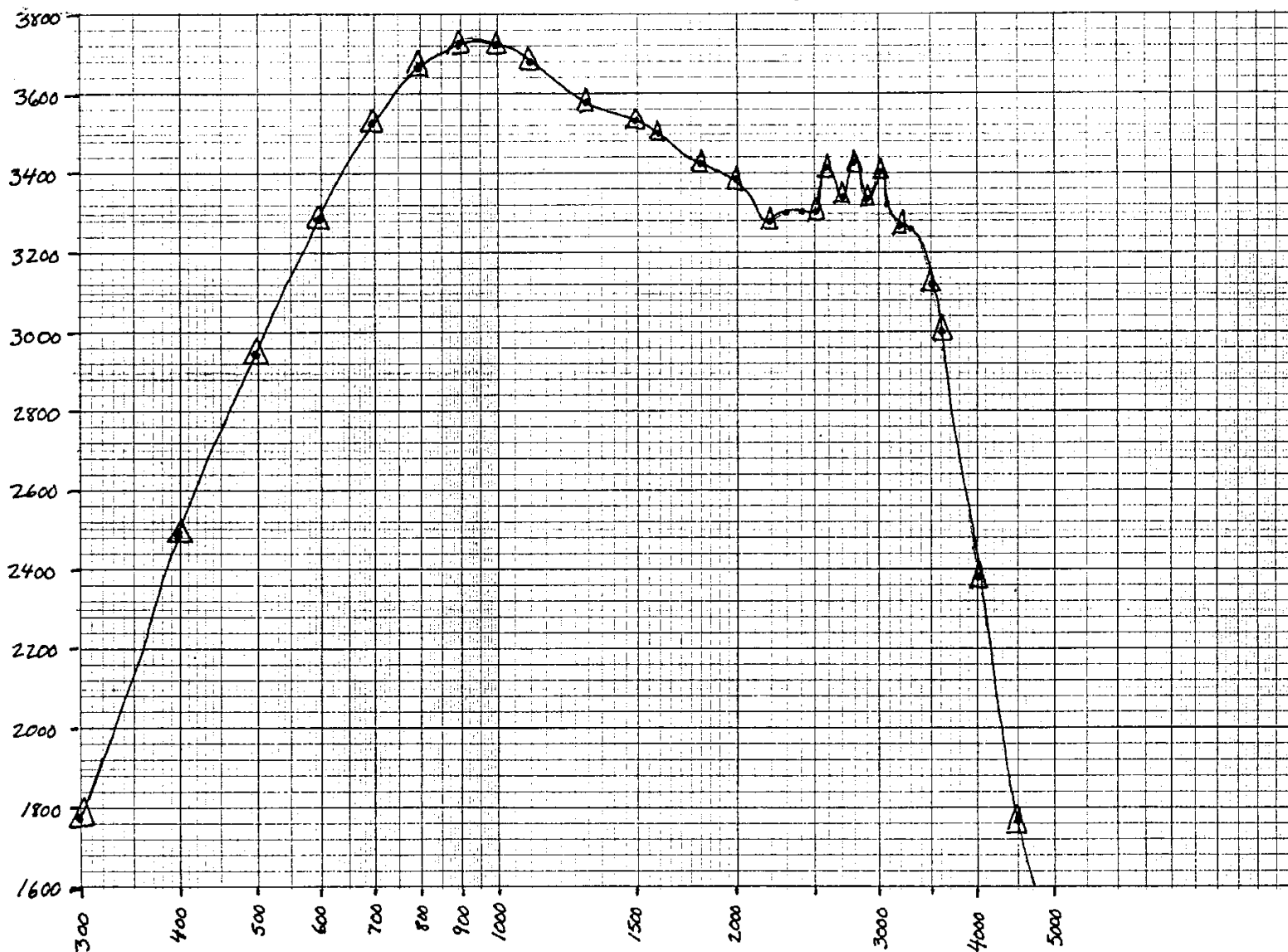
Requirement 47CFR 2.1047 (b)
Test Method EIA-TIA-603 (93)
PARA. 2.2.3

COM 400CC

MODULATION LIMITING

Figure 3

MAXIMUM DEVIATION (HZ)
with detector at positive peak



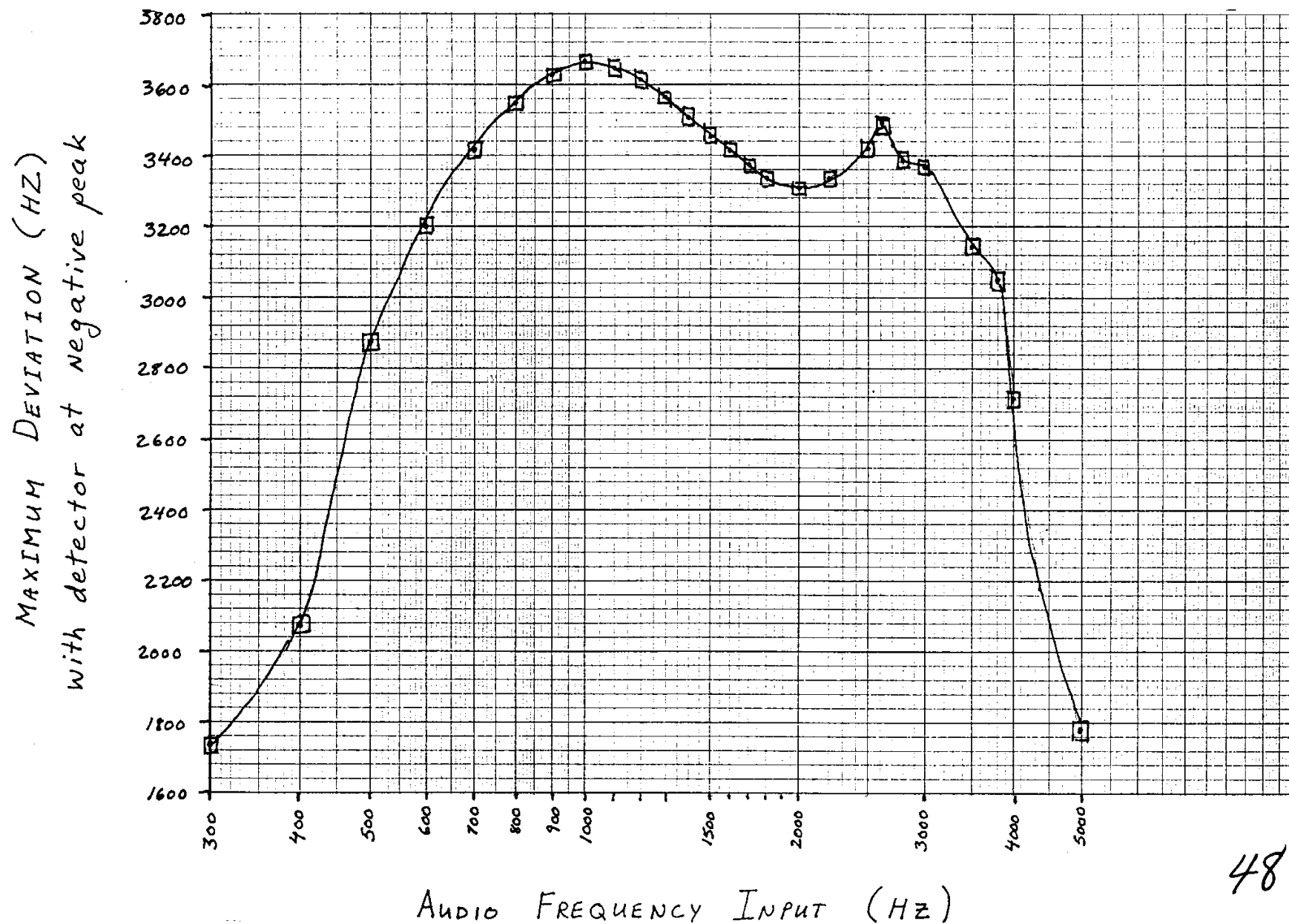
AUDIO FREQUENCY INPUT (HZ)

REQUIREMENT 47CFR 2.1047(b)

TEST METHOD EIA-TIA-603(93)
PARA. 2.2.3

COM400CC
MODULATION LIMITING

Figure 4



5 SUMMARY:

All tests according to *FCC Part 2, Paragraphs 2.1053, 2.1049, 2.1051; and Part 90, Paragraph 90.217** were

■ - Performed

□ - **Not** Performed

The Equipment Under Test

■ - **Fulfills** the *FCC Part 2, Paragraphs 2.1053, 2.1049, 2.1051; and Part 90, Paragraph 90.217** requirements.

- TÜV PRODUCT SERVICE, INC. -

Responsible Engineer:



Jim Owen (EMC Engineer)

(*) 2.1055 tests performed by HM Electronics. See Attestation Statement.