FCC CERTIFICATION TEST REPORT

prepared for

Codan Proprietary Ltd.
PO Box 96
Campbelltown, South Australia 5074
Australia

FCC ID: DYYNGT-1

December 18, 2000

WLL PROJECT #: 5337H

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WASHINGTON LABORATORIES, LTD.
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STATEMENT OF QUALIFICATIONS

for

Chad M. Beattie

Washington Laboratories, Ltd.

I am a NARTE-Accredited EMC Test Laboratory Engineer with an Associates in Electronic Systems Technology. I have nine years of electronics experience, the last five years being directly involved in EMI testing. I am qualified to perform EMC testing to the methods described in this test report. The measurements taken within this report are accurate within my ability to perform the tests and within the tolerance of the measuring instrumentation.

By: 
Chad M. Beattie
Compliance Engineer

Date: MAY 15, 2000

FCC CERTIFICATION REPORT

for

Codan Proprietary Ltd.

1.0 Introduction

This report has been prepared on behalf of Codan Proprietary Ltd. in support of their application for FCC Certification under Part 90 of the FCC Rules and Regulations.

The Equipment Under Test was the NGT Transceiver (HF Transceiver)

All measurements were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code 200066-0) as an independent FCC test laboratory.

Measurements were made on the Equipment Under Test in accordance with FCC Rule Part 2, specifically the requirements stipulated in:

2.1046 RF Power Output
2.1047 Modulation Characteristics
2.1049 Occupied Bandwidth
2.1051 Spurious Emissions at Antenna Terminals
2.1053 Field Strength of Spurious Radiation
2.1055 Frequency Stability

All results reported herein relate only to the item tested. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix D for Statement of Measurement Uncertainty.

1.1 Summary

The Codan Proprietary Ltd. NGT Transceiver complies with the technical requirements of Part 90 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The Codan NGT Transceiver is a SSB transceiver that can be installed in a vehicle or used as a base station. The NGT system is comprised of a 2020 Handset, 2030 Junction Box and the 2101 RF Unit. The handset is a hand-held device with a microphone, press-to-talk (PTT) button, display and keypad. Two models of the NGT 2010 are available. The models are identical, having the same hardware. The only difference between the two is software features. The VR only has 15 channels and ALE is not available. The Junction Box is a unit to which the handset, RF unit, speaker and related items are connected. The units are connected together via the use of the Codan Interconnect Bus (CIB). The following are the specifications of the unit.

Frequency Range:	1.6 MHz to 30 MHz.
Modulation:	SSB (J3E), H3E and J2B
Type of information:	Voice, ALE, selcall
Number of Channels:	1000 (SR), 15 (VR)
Maximum Output Power:	100 Watts PEP

3.0 Test Configuration

During testing, the EUT was configured with a 2020 handset and speaker connected to the 2030 junction box which was connected to the NGT RF unit. The transmitter was tested at 1.6 MHz (low channel), 15.6 MHz (mid channel), and 29.9 MHz (high channel).

I/O Ports	I/O Cables
2-pin DC input cable adapter	>1m unshielded, DC power source to EUT
6-pin DIN	6 inch shielded, not used.
8-pin DIN	>1 m shielded, Transceiver to junction box
F-type RF output	>1 m coaxial, Transceiver to load (RF)

3.1 RF Output Power (FCC Rule Part 2.1046)

The output from the transmitter was connected to a 50dB attenuator and then to the input of a HP 8564E RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the 50dB attenuator. Two tones (500Hz and 2400Hz) with equal audio levels were provided and adjusted to produce the full PEP. The RF output power across a 50 ohm load termination was measured directly by the analyzer.

RESULTS: The measured RF output power at 1.61MHz was 50.2 dBm, or 104.7 W PEP.

RESULTS: The measured RF output power at 15.6MHz was 50.1 dBm, or 102.3 W PEP.

RESULTS: The measured RF output power at 29.91MHz was 50.3 dBm, or 107.2 W PEP.

3.2 Modulation Characteristics (FCC Rule Part 2.1047)

A curve of the transmit audio frequency response from 0Hz to 5000Hz is included as Plot #1 in Appendix A. This data was obtained at the audio output test point located on the Audio Interface Board at TXAUD102. The Single Sideband filter frequency response is included as Plot #2 in Appendix A. A curve is also included which shows the RF power output limiting over the modulation input voltage. This is included as Plot #3 in Appendix A. This testing was performed while in the 15.6MHz (Mid) channel.

3.3 Occupied Bandwidth (FCC Rule Part 2.1049)

The occupied bandwidth was measured by supplying the EUT with two audio tones (400Hz and 1800Hz). The occupied bandwidth of the transceiver was measured at 1.61MHz (Low), 15.6MHz (Mid) and 29.9MHz (High) channels. The RF output of the EUT was connected to the Hewlett Packard Spectrum Analyzer (M/N: HP 8564E) via a 50dB attenuator. The spectrum analyzer measurement resolution bandwidth and video bandwidth were set to 100 Hz.

Results of the bandwidth testing are displayed in Appendix B for each channel.

3.4 Spurious Emissions at Antenna Terminals (FCC Rule Part 2.1051)

Spurious emissions were measured by connecting the antenna terminals to the input of an HP 8564E spectrum analyzer via a 50dB attenuator. The unit was supplied with two audio tones (400Hz and 1800Hz). Per Section 90.210(a) of the FCC Rules, the power of any emission shall be attenuated below the unmodulated carrier power by the following:

1) On any frequency removed from the assigned frequency by more than 50%, but not more than 150% of the authorized bandwidth: at least 25 dB.

2) On any frequency removed from the assigned frequency by more than 150%, but not more than 250% of the authorized bandwidth: At least 35 dB

3) On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: At least 43 + 10 log P dB.

For the EUT:

$$43 + 10 \text{ Log } (100) \text{ W} = 63 \text{ dB}$$

The emissions were checked up to the tenth harmonic of the carrier frequency. Appendix C shows plots of the spurious emissions up to the 10^{th} harmonic.

RESULTS: The EUT complies with the emission mask requirements of Section 90.210(a) of the FCC Rules for the three channels tested. Plots in Appendix C depict the emission mask, unmodulated signal power, and spurious emission level.

3.5 Radiated Emissions Testing (FCC Rule Part 2.1053)

The EUT was placed on an 80 cm high, 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3 meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Broadband and Loop antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The loop antenna was rotated about its' horizontal and vertical axis to maximize the emissions. Horizontal and vertical field components were measured.

The output from the antenna was connected, via a preselector or preamplifier, to the input of the spectrum analyzer. The detector function was set to peak. For emissions above 30MHz, the measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For emissions below 30 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 9 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.5.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limit, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dBµV to obtain the Radiated Electric Field in dBµV/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Voltage: VdBµV

Composite Antenna Factor: AFcdB/m

Electric Field: EdBuV/m = VdBµV + AFcdB/m

To convert to linear units: EµV/m=antilog (EdBµV/m/20)

RESULTS: The EUT complies with the requirements. Data is recorded in Table 1.
LIMIT: 84.4 dBµV/m (16595.90 uV/m)

Table 1: FCC Part 90 10M Radiated Emissions Data

CLIENT: Codan
MODEL NO: Transceiver NGT (SSB)
DATE: 24 Aug 99
CLOCK SPEED: 29.91 MHz CH.3
BY: Chad M. Beattie
JOB #: 5337H

Frequency MHz	Polarity H/V	Azimuth Degree	Ant Height m	SA Level (QP) dBuV	AFc dB/m	E-Field dBuV/m	Limit dBuV/m	Margin dB	
59.81	V	180.0	1.0	45.8	11.0	56.8	84.4	-27.6	
59.81	H	90.0	4.0	38.3	11.0	49.3	84.4	-35.1	10kHz
89.72	V	135.0	1.0	66.1	11.4	77.5	84.4	-6.9	
89.72	H	270.0	4.0	50.0	11.4	61.4	84.4	-23.0	
119.63	V	315.0	1.0	54.9	13.2	68.1	84.4	-16.3	
119.63	H	225.0	4.0	54.7	13.2	67.9	84.4	-16.5	
149.54	V	315.0	1.0	56.8	10.6	67.4	84.4	-17.0	
149.54	H	90.0	4.0	48.3	10.6	58.9	84.4	-25.5	
179.46	V	90.0	1.0	44.1	12.1	56.2	84.4	-28.2	
179.46	H	270.0	4.0	52.4	12.1	64.5	84.4	-19.9	
209.36	V	180.0	1.0	48.0	13.7	61.7	84.4	-22.7	
209.36	H	270.0	4.0	50.3	13.7	64.0	84.4	-20.4	
239.27	V	315.0	1.0	43.9	15.8	59.7	84.4	-24.7	
239.27	H	270.0	4.0	42.0	15.8	57.8	84.4	-26.6	
269.19	V	45.0	1.0	29.5	15.0	44.5	84.4	-39.9	
269.19	H	270.0	4.0	35.4	15.0	50.4	84.4	-34.0	
299.10	V	315.0	1.0	39.5	16.4	55.9	84.4	-28.5	
299.10	H	225.0	4.0	41.5	16.4	57.9	84.4	-26.5	

Table 1 (Cont'd.): FCC Part 90 10M Radiated Emissions Data

CLIENT: Codan
MODEL NO: Transceiver NGT (SSB)
DATE: 24 Aug 99
CLK SPEED(S): 15.6 MHz CH.2
BY: Chad M. Beattie
JOB #: 5337H

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (QP) dBuV	AFc dB/m	E-Field dBuV/m	Limit dBuV/m	Margin dB
31.20	V	0.0	1.0	14.0	16.5	30.5	84.4	-53.9
31.20	H	90.0	4.0	12.7	16.5	29.2	84.4	-55.2
46.80	V	90.0	1.0	36.0	15.9	51.9	84.4	-32.5
46.80	H	0.0	4.0	33.2	15.9	49.1	84.4	-35.3
62.40	V	45.0	1.0	41.2	9.9	51.1	84.4	-33.3
62.40	H	90.0	4.0	35.4	9.9	45.3	84.4	-39.1
78.00	V	90.0	1.0	61.1	9.6	70.7	84.4	-13.7
78.00	H	180.0	4.0	52.2	9.6	61.8	84.4	-22.6
93.60	V	180.0	1.0	39.8	12.0	51.8	84.4	-32.6
93.60	H	225.0	4.0	27.8	12.0	39.8	84.4	-44.6
109.20	V	90.0	1.0	51.2	13.1	64.3	84.4	-20.1
109.20	H	225.0	4.0	46.3	13.1	59.4	84.4	-25.0
124.80	V	0.0	1.0	39.6	12.7	52.3	84.4	-32.1
124.80	H	90.0	4.0	39.7	12.7	52.4	84.4	-32.0
140.40	V	270.0	1.0	42.9	11.4	54.3	84.4	-30.1
140.40	H	45.0	4.0	38.8	11.4	50.2	84.4	-34.2
156.00	V	270.0	1.0	40.4	10.9	51.3	84.4	-33.1
156.00	H	90.0	4.0	34.8	10.9	45.7	84.4	-38.7

Table 1 (Cont'd.): FCC Part 90 10M Radiated Emissions Data

CLIENT: Codan
MODEL NO: Transceiver NGT (SSB)
DATE: 24 Aug 99
CLK SPEED(S): 1.61 MHz CH.1
BY: Chad M. Beattie
JOB #: 5337H

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level (QP) dBuV	AFc dB/m	E-Field dBuV/m	Limit dBuV/m	Margin dB
3.23	V	270.0	1.0	28.4	12.3	40.7	84.4	-43.7
4.84	V	270.0	1.0	46.3	12.3	58.6	84.4	-25.8
6.45	V	270.0	1.0	20.0	12.2	32.2	84.4	-52.2
8.06	V	270.0	1.0	41.1	12.1	53.2	84.4	-31.2
11.28	V	270.0	1.0	4.0	10.6	14.6	84.4	-69.8
12.89	V	180.0	1.0	10.0	9.8	19.8	84.4	-64.6
14.50	V	180.0	1.0	4.5	9.9	14.4	84.4	-70.0
16.11	H	180.0	1.0	5.6	10.0	15.6	84.4	-68.8

3.6 Frequency Stability (FCC Rule Part 2.1055)

The requirements of Part 90 of the FCC Rules and Regulations call for the carrier frequency to be stable under different power supply voltages and over a wide temperature extreme.

The EUT is powered by DC voltage supplied externally. The manufacturers power requirements for the EUT include the following:

Low DC Voltage of 9 VDC (manufacturer's specification)
High DC Voltage of 16 VDC (manufacturer's specifications)

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured with the Racal-Dana Model 1992 Frequency Counter while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The following are the reference frequencies at ambient for the Low, Middle, and High channels.

Low Channel: 1.6118060 MHz

Mid Channel: 15.601799 MHz

High Channel: 29.911794 MHz

The limit is 50Hz for channels below 25 MHz and 20 ppm for channels 25 MHz and up.

Limit = $(29.911794 \times 10^{6}$ Hz) x (20×10^{-6}) = 598.23 Hz (High Channel)

3.6.1 Frequency Stability for Voltage Variation

The carrier was measured while the transmitter was powered by 11.56 VDC and then 15.64 VDC. The baseline measurement was made while being powered at 13.6 VDC. The unit was allowed to stabilize before the carrier frequency was taken.

The results are as follows:

Channel	Voltage (Volts DC)	Frequency (MHz)	Deviation (Hz)	Limit (Hz)
Low Channel	13.60	1.60999900	0.00	25.0
	11.56	1.60999900	0.00	25.0
	15.64	1.60999910	0.10	25.0
Mid Channel	13.60	15.59999360	0.00	25.0
	11.56	15.59999390	0.30	25.0
	15.64	15.59999460	1.00	25.0
High Channel	13.60	29.90998620	0.00	598.2
	11.56	29.90998580	-0.40	598.2
	15.64	29.90998480	-1.40	598.2

3.6.2 Frequency Stability for Temperature Variation

The carrier frequency was measured at 10 degree intervals as the temperature was increased from -30°C to +50°C over the course of 8 hours. The unit was brought to temperature and allowed to stabilize before the carrier frequency was taken.

The results are as follows:

Temperature (Celsius)	Frequency (MHz)	Deviation (Hz)	Limit (Hz)
Low Channel			
-30	1.60999850	0.00	50.0
-20	1.60999840	-0.10	50.0
-10	1.60999860	0.10	50.0
0	1.60999850	0.00	50.0
10	1.60999840	-0.10	50.0
20	1.60999850	0.00	50.0
30	1.60999870	0.20	50.0
40	1.60999970	1.20	50.0
50	1.61000050	2.00	50.0

Temperature (Celsius)	Frequency (MHz)	Deviation (Hz)	Limit (Hz)
Mid Channel			
-30	15.59998600	0.00	50.0
-20	15.59998500	-1.00	50.0
-10	15.59998700	1.00	50.0
0	15.59998500	-1.00	50.0
10	15.59998500	-1.00	50.0
20	15.59998600	0.00	50.0
30	15.59998900	3.00	50.0
40	15.59999500	9.00	50.0
50	15.59999700	11.00	50.0

Temperature (Celsius)	Frequency (MHz)	Deviation (Hz)	Limit (Hz) 20ppm
High Channel			
-30	29.909974	1.0	598.20
-20	29.909971	-2.0	598.20
-10	29.909975	2.0	598.20
0	29.909972	-1.0	598.20
10	29.909970	-3.0	598.20
20	29.909973	0.0	598.20
30	29.909980	7.0	598.20
40	29.909995	22.0	598.20
50	29.909998	25.0	598.20

Table 2: Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP8564E

Hewlett-Packard Spectrum Analyzer: HP8568B

Hewlett-Packard Spectrum Analyzer: HP8593A

Hewlett-Packard Quasi-Peak Adapter: HP85650A

Hewlett-Packard Preselector: HP85685A

Hewlett-Packard Preamplifier: HP8449B

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)

EMCO Loop Antenna: Model 6502

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8012-50-R-24-BNC

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8028-50-TS-24-BNC

AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)

AH Systems, Inc. Motorized Turntable (Site 2)

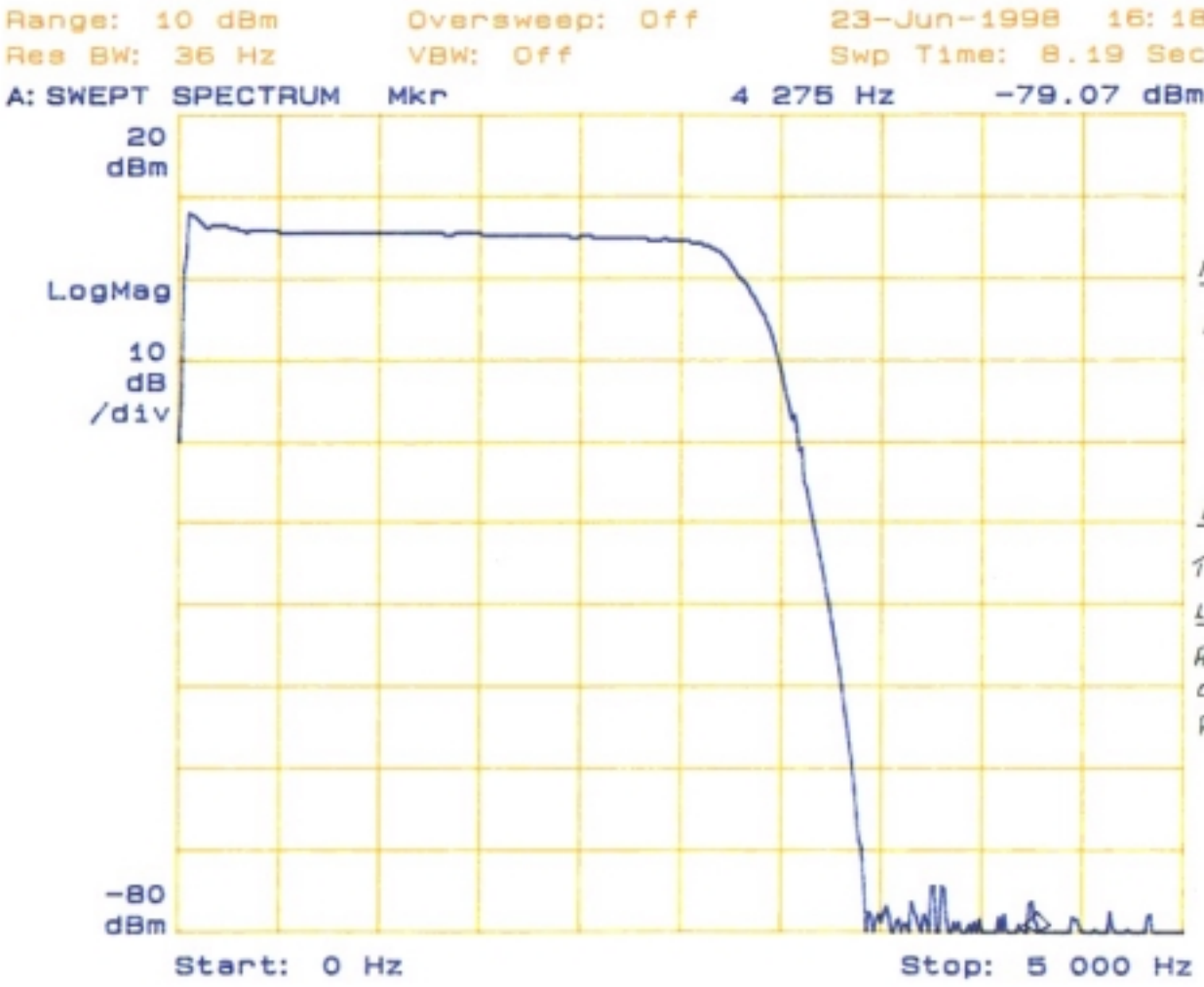
RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

APPENDIX A

MODULATION CHARACTERISTICS

TRANSMIT AUDIO FREQUENCY RESPONSE



AUDIO INPUT:-

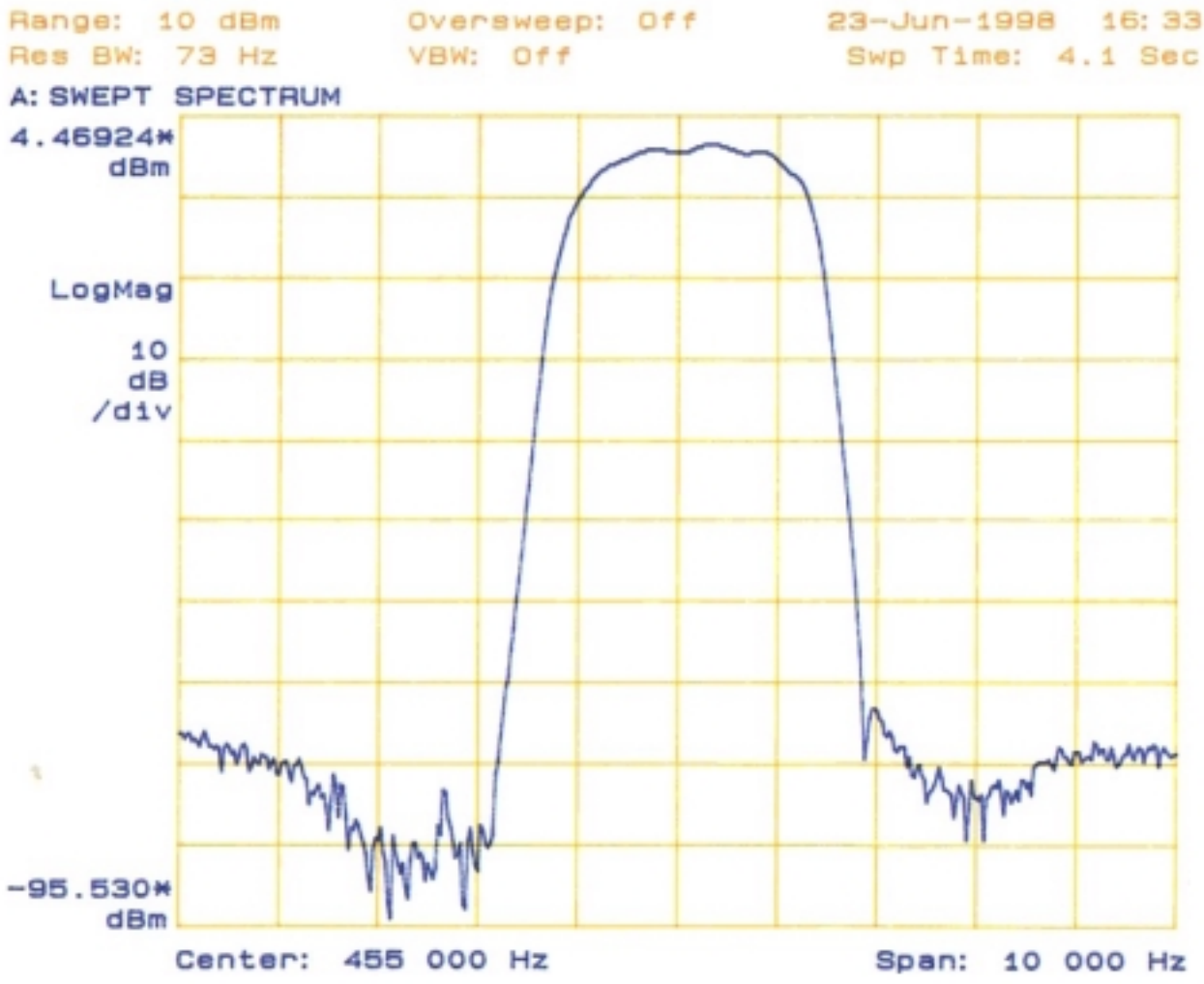
GP IN/OUT CONNECTOR.
PINS 5 & 15. @ 300mV RMS

AUDIO OUTPUT:-

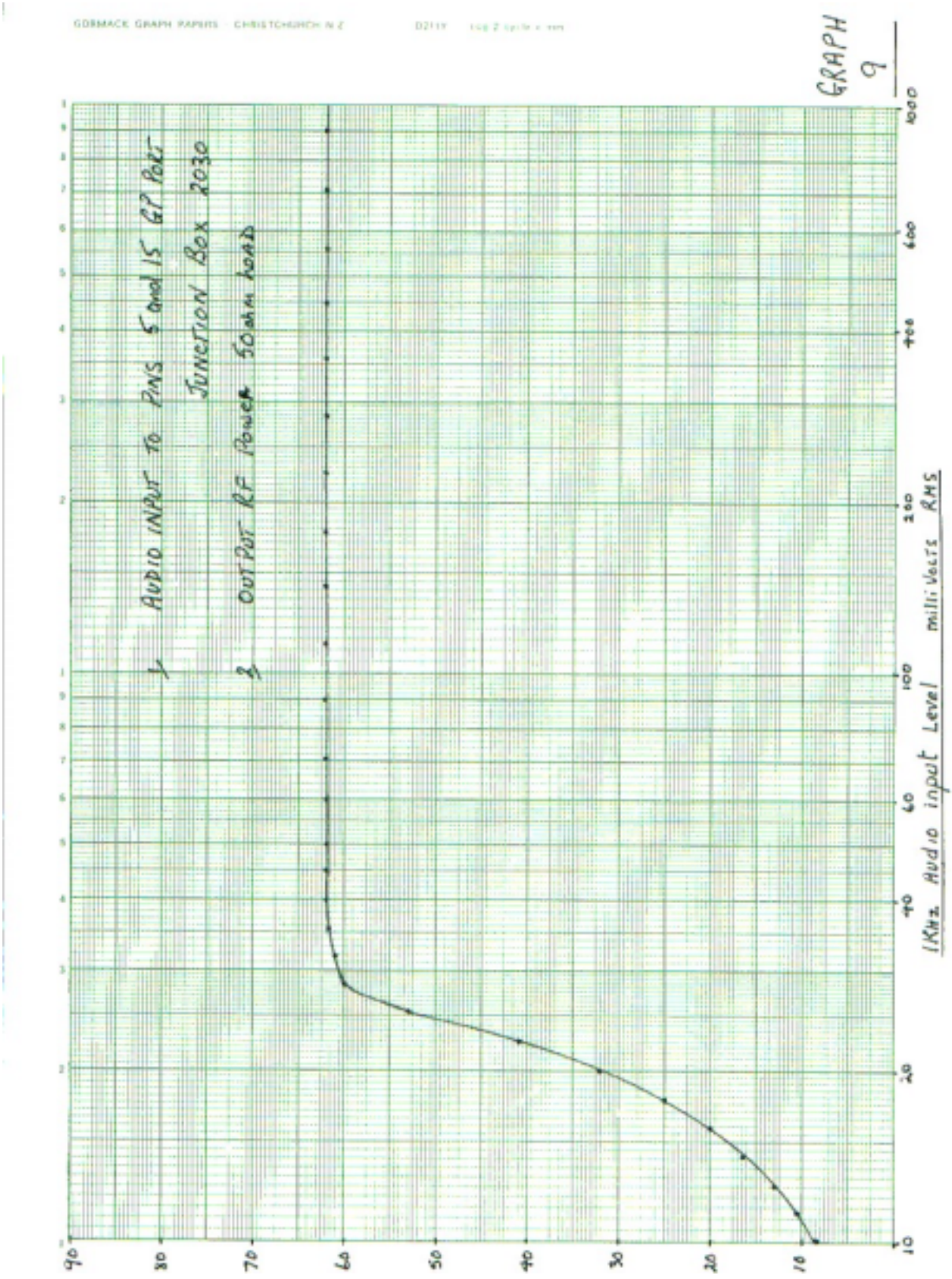
TEST POINT- TXAUD102
LOCATED ON
AUDIO INTERFACE PCB.
08-05266-001
RF UNIT 2010

GRAPH 8

Single Sideband filter frequency response

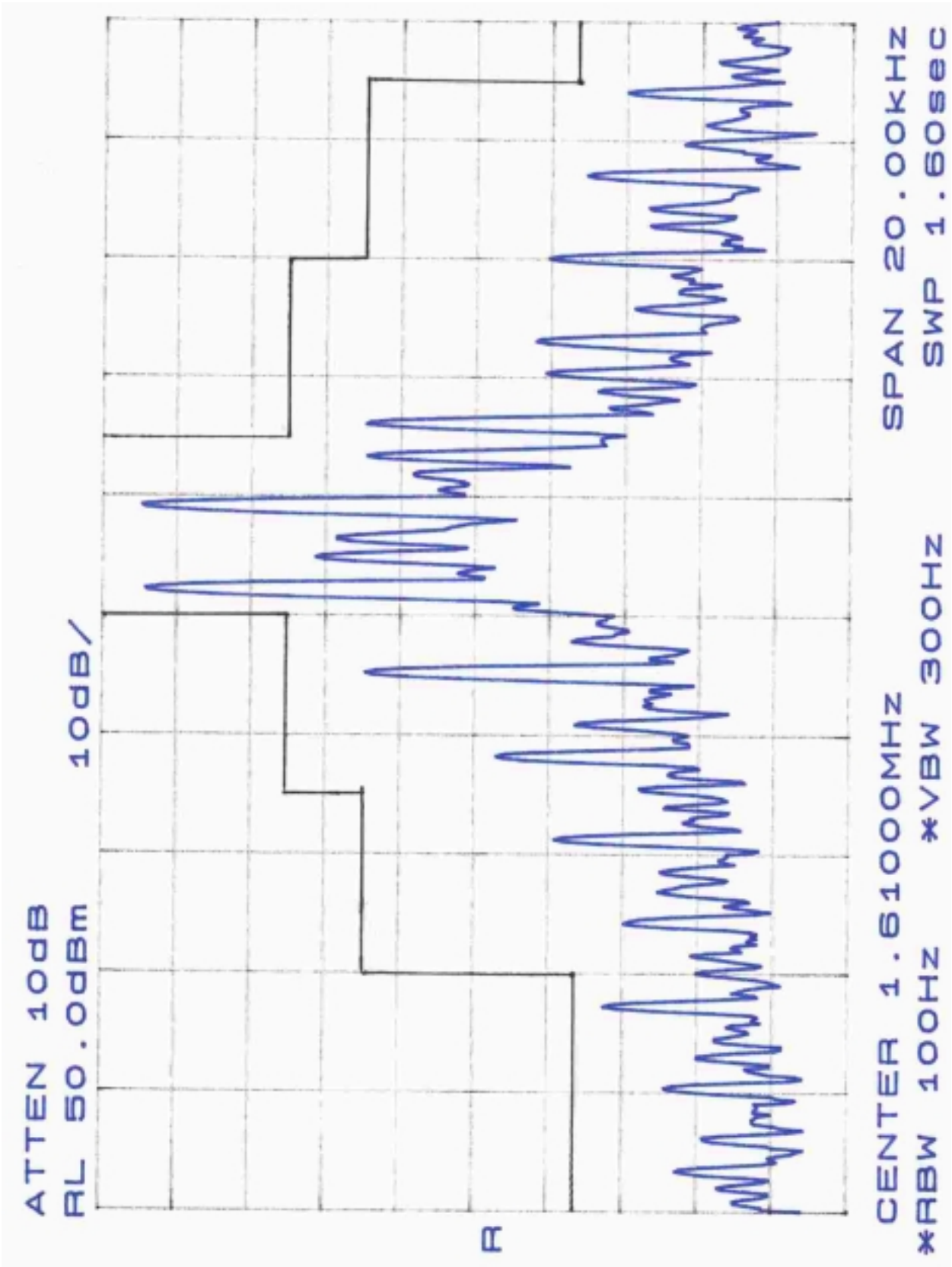


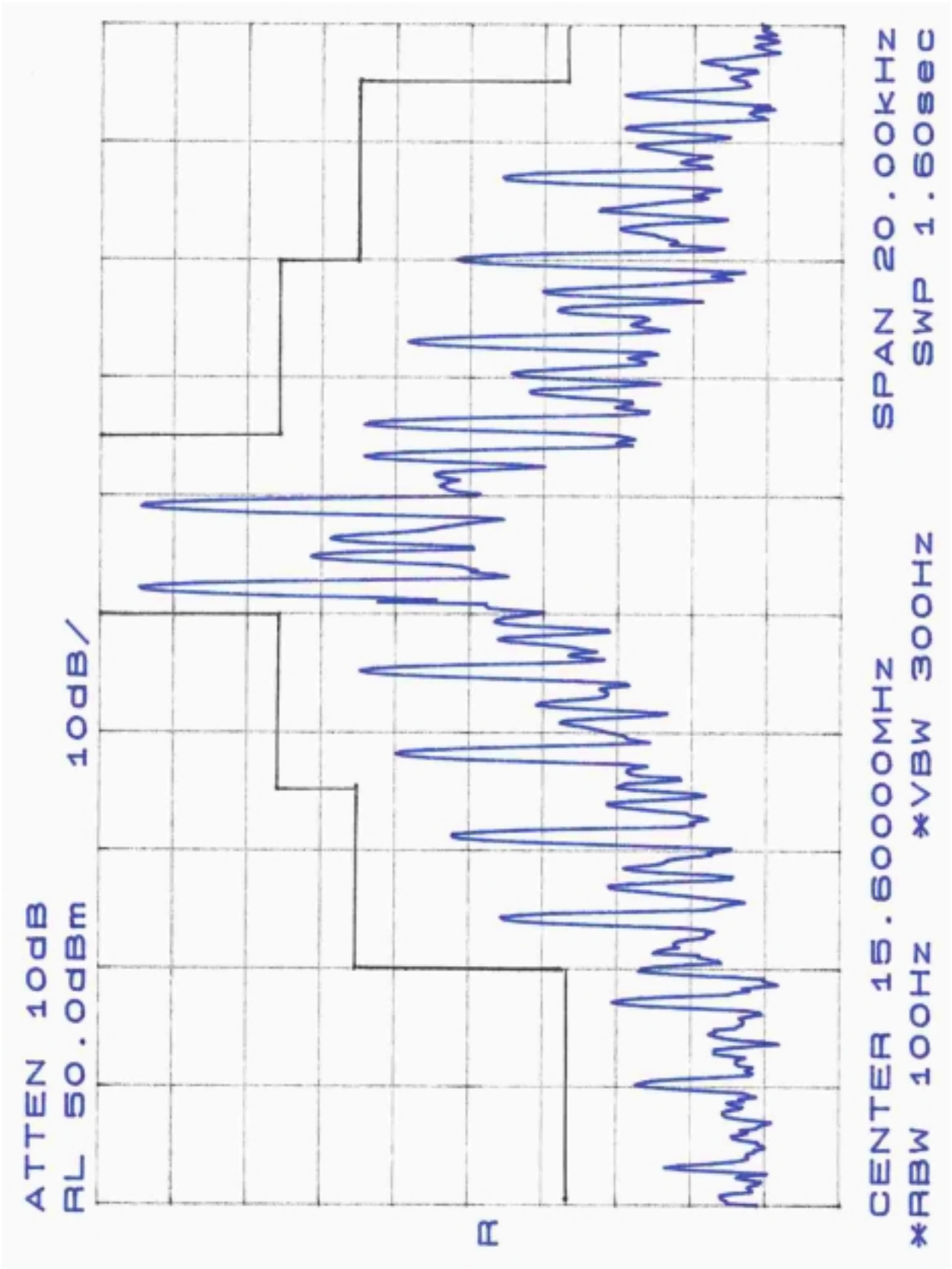
GRAPH 7

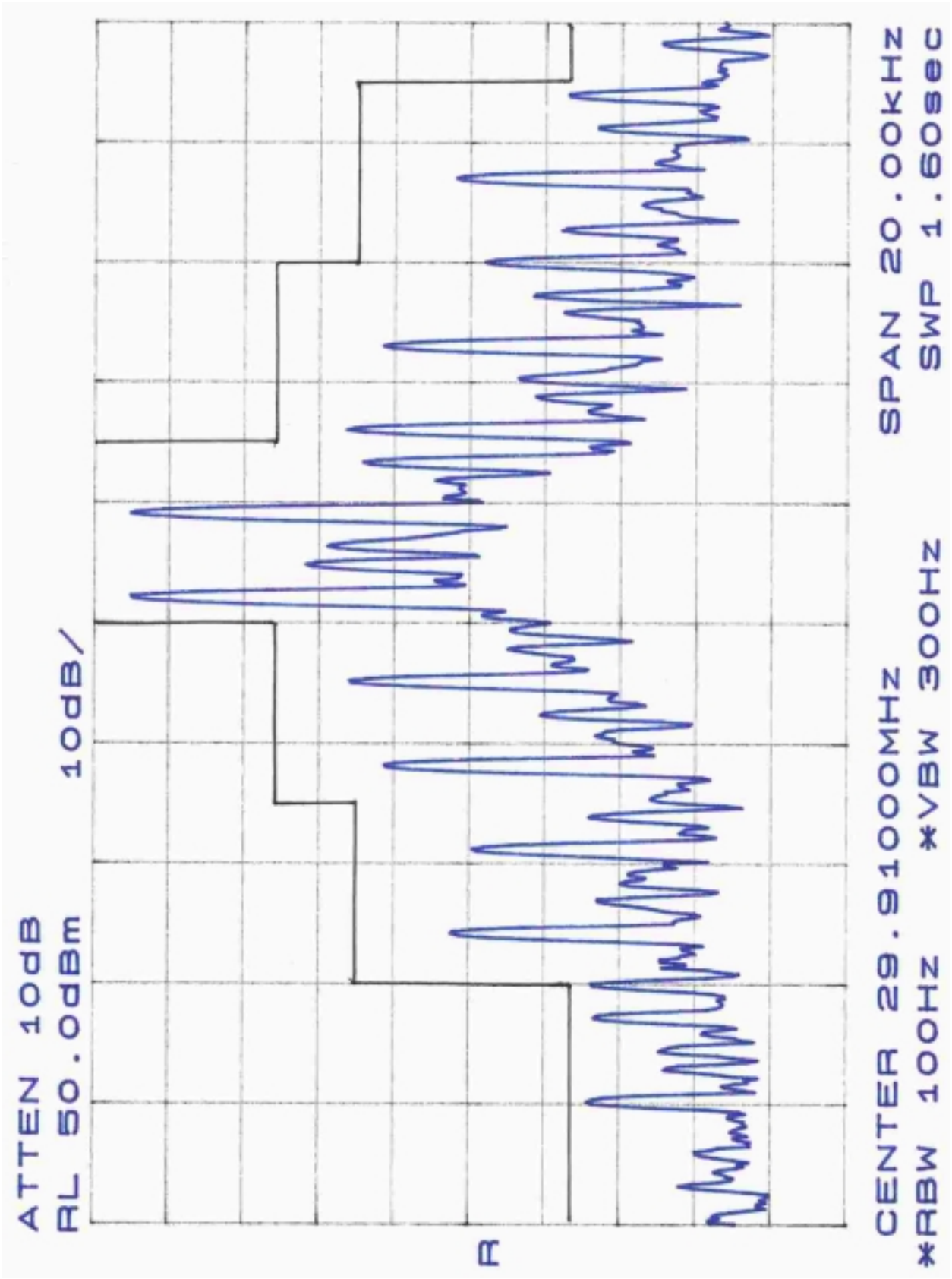

GRAPH 9
1 Audio INPUT To PINS 5 and 15 GP Port Junction Box 2030
2 OutPut RF Power 50ohm load
1KHz Audio input Level milli Volts RMS
10
20
40
60
100
200
400
1000
10
20
30
40
50
60
70
80
90

APPENDIX B

BANDWIDTH PLOTS

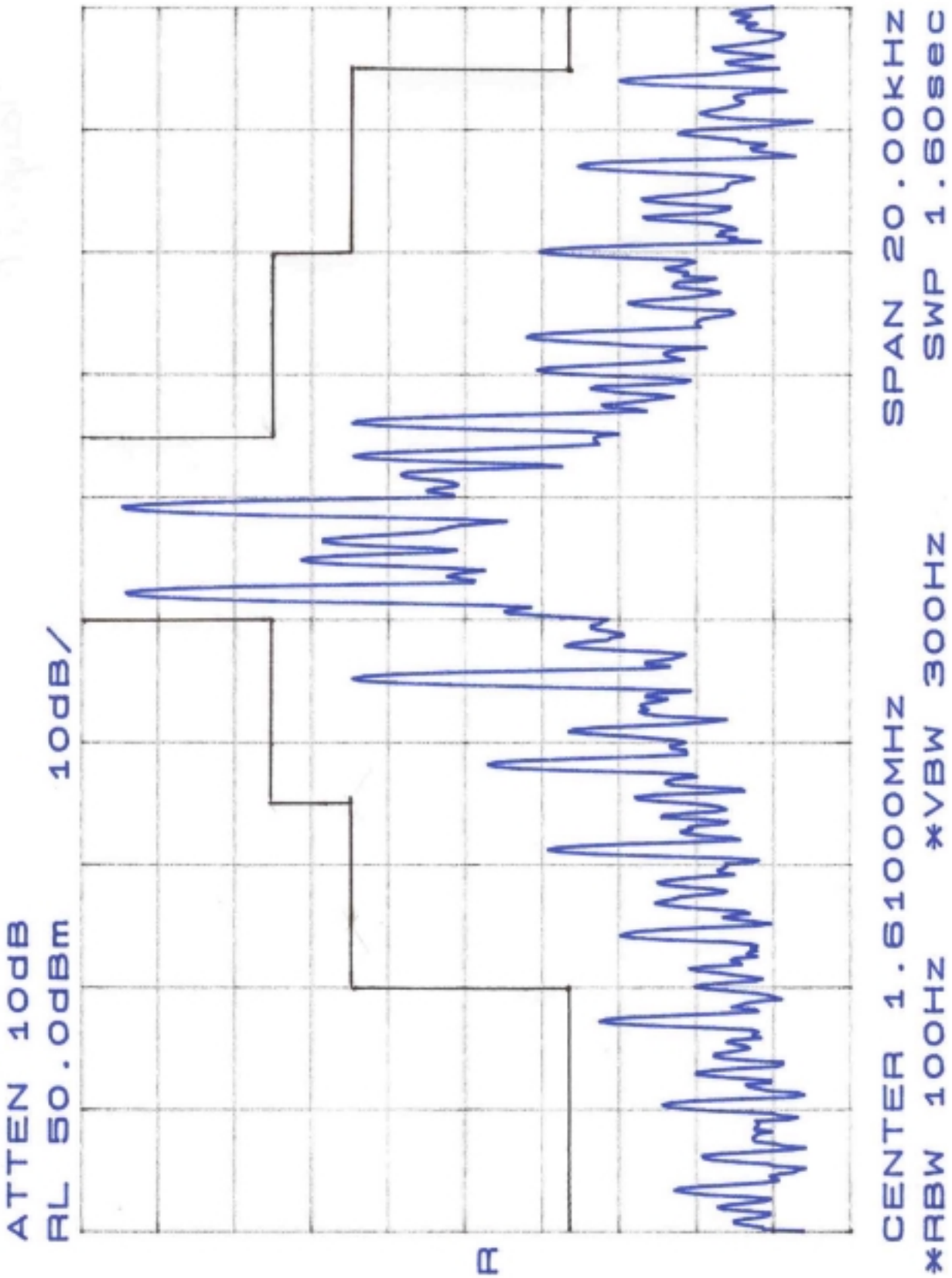

ATTEN 10dB
RL 50.0dBm
10dB/
R
CENTER 1.61000MHz
SPAN 20.00kHz
*RBW 100Hz
*VBW 300Hz
SWP 1.60sec

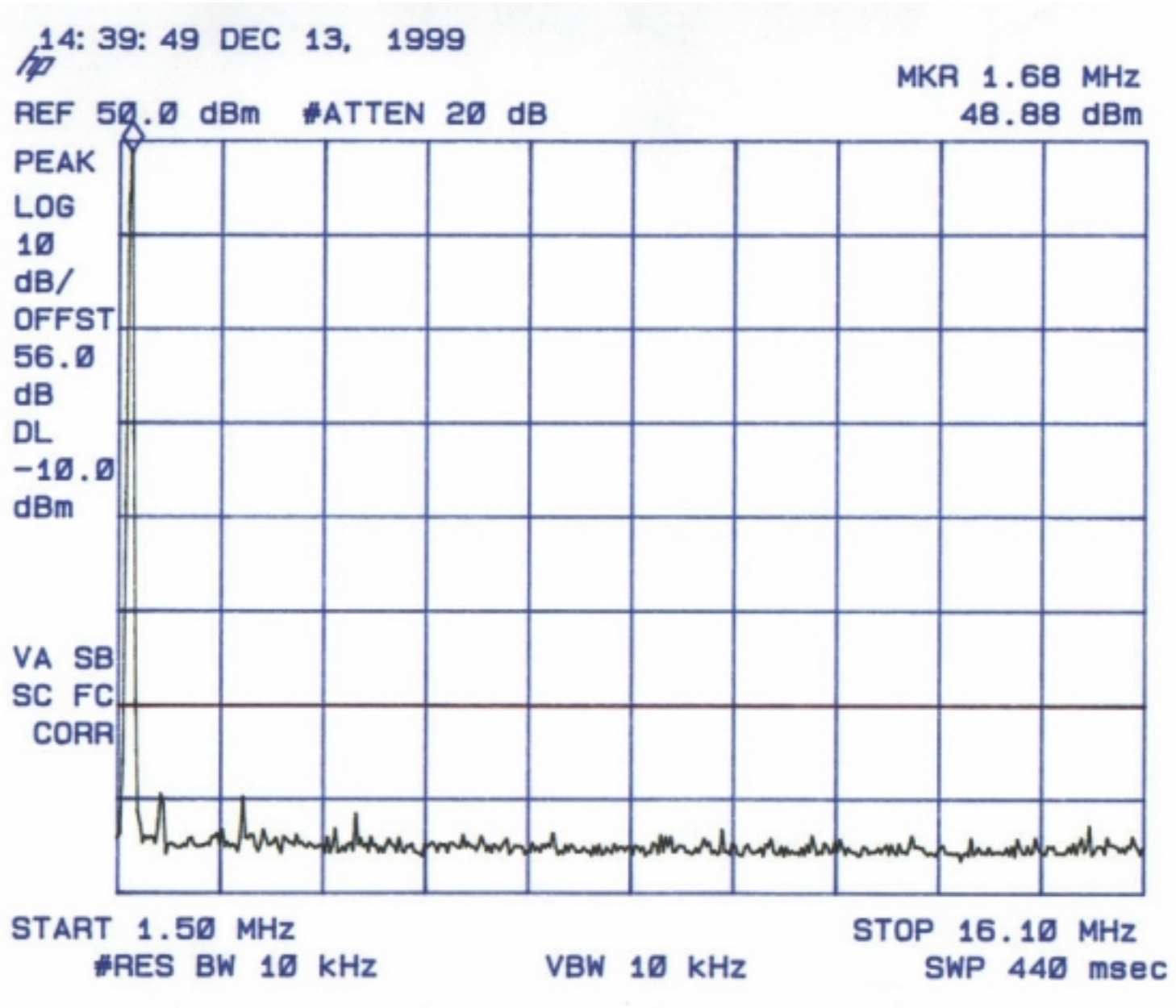

ATTEN 10dB
RL 50.0dBm
10dB/
R
CENTER 15.60000MHz
SPAN 20.00kHz
*RBW 100Hz
*VBW 300Hz
SWP 1.60sec

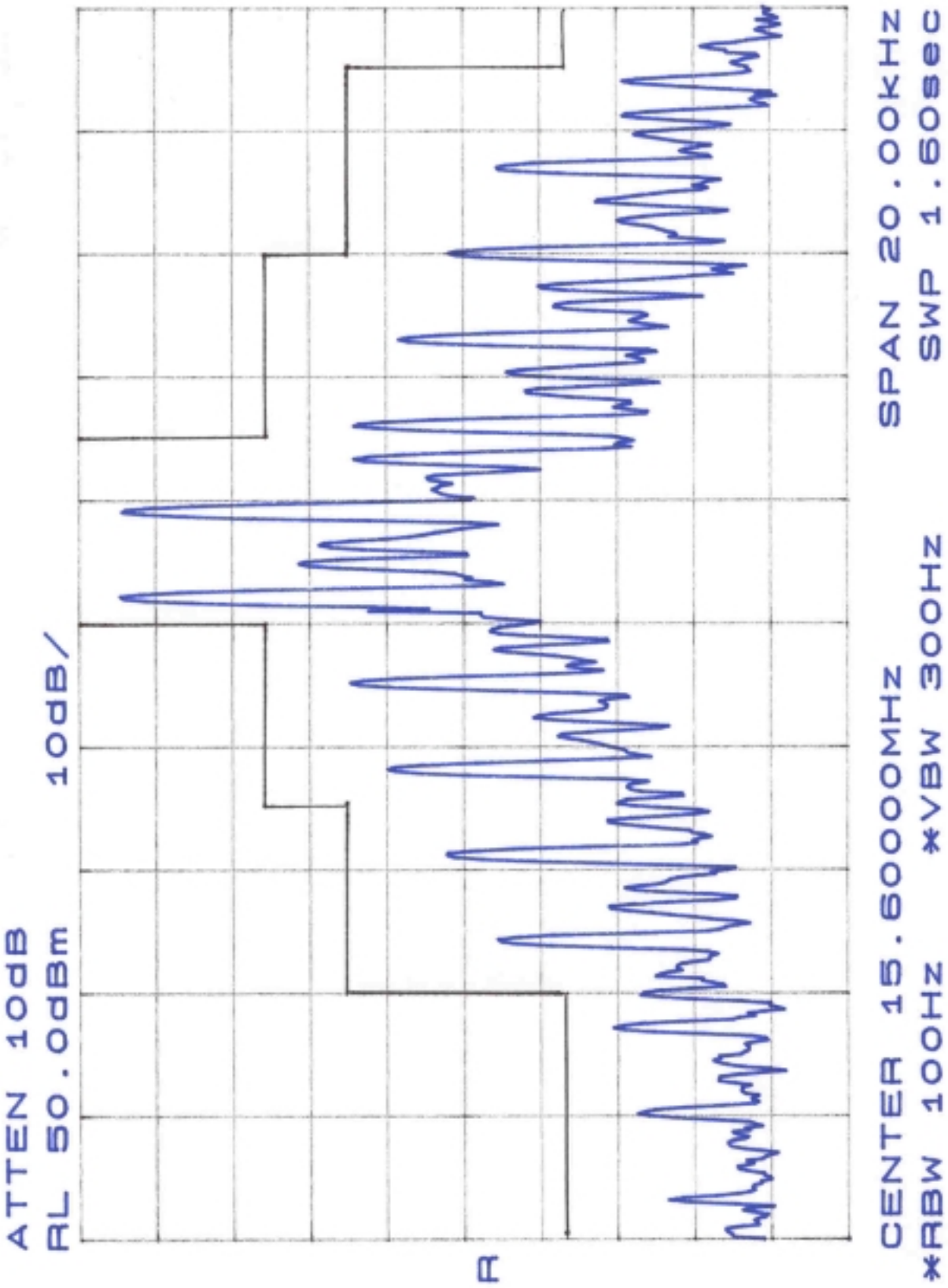

ATTEN 10dB
RL 50.0dBm
10dB/
CENTER 29.91000MHz
*RBW 100Hz
*VBW 300Hz
SPAN 20.00kHz
SWP 1.60sec

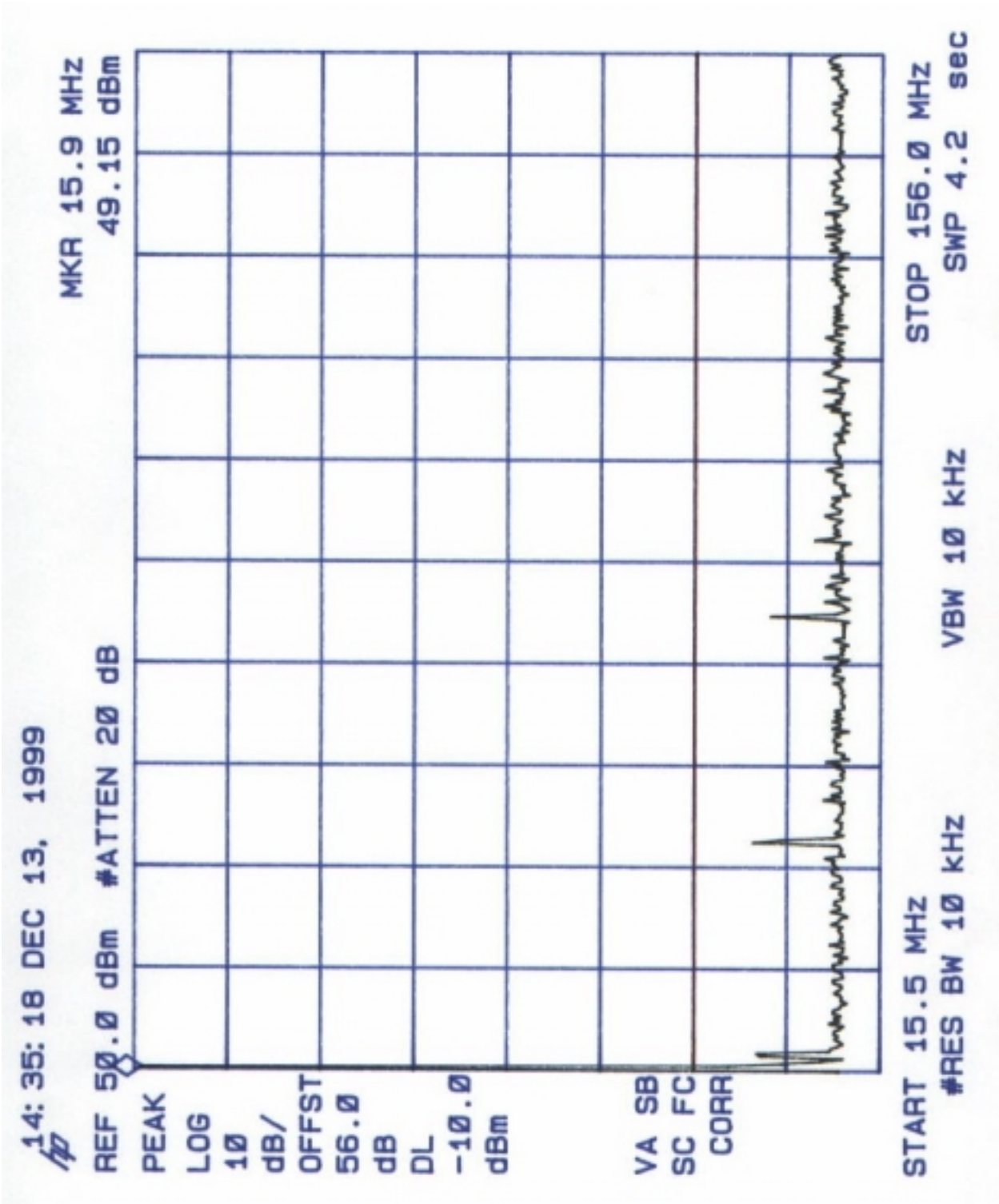
APPENDIX C

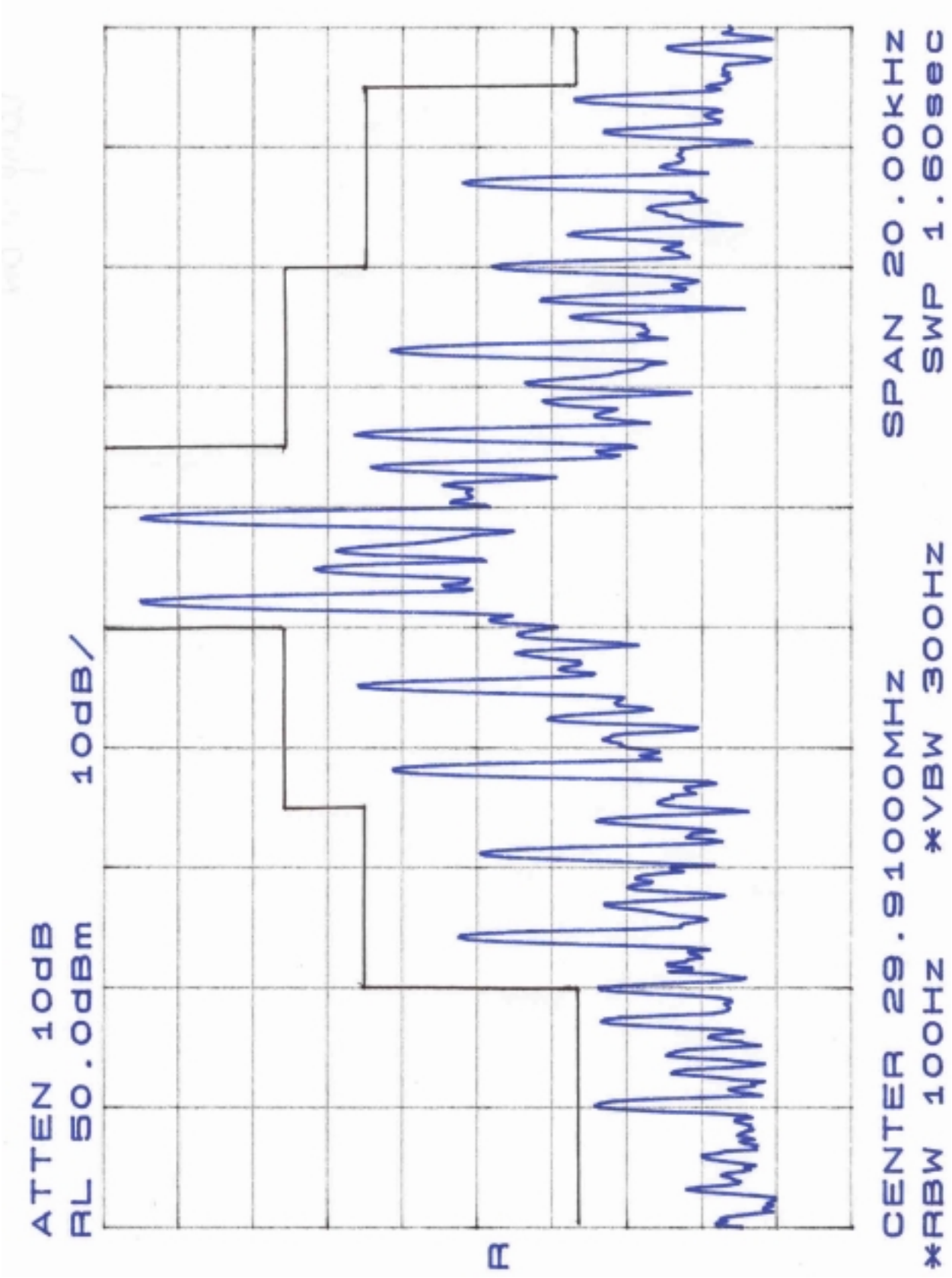
PLOTS OF CONDUCTED SPURIOUS EMISSIONS AT ANTENNA TERMINAL

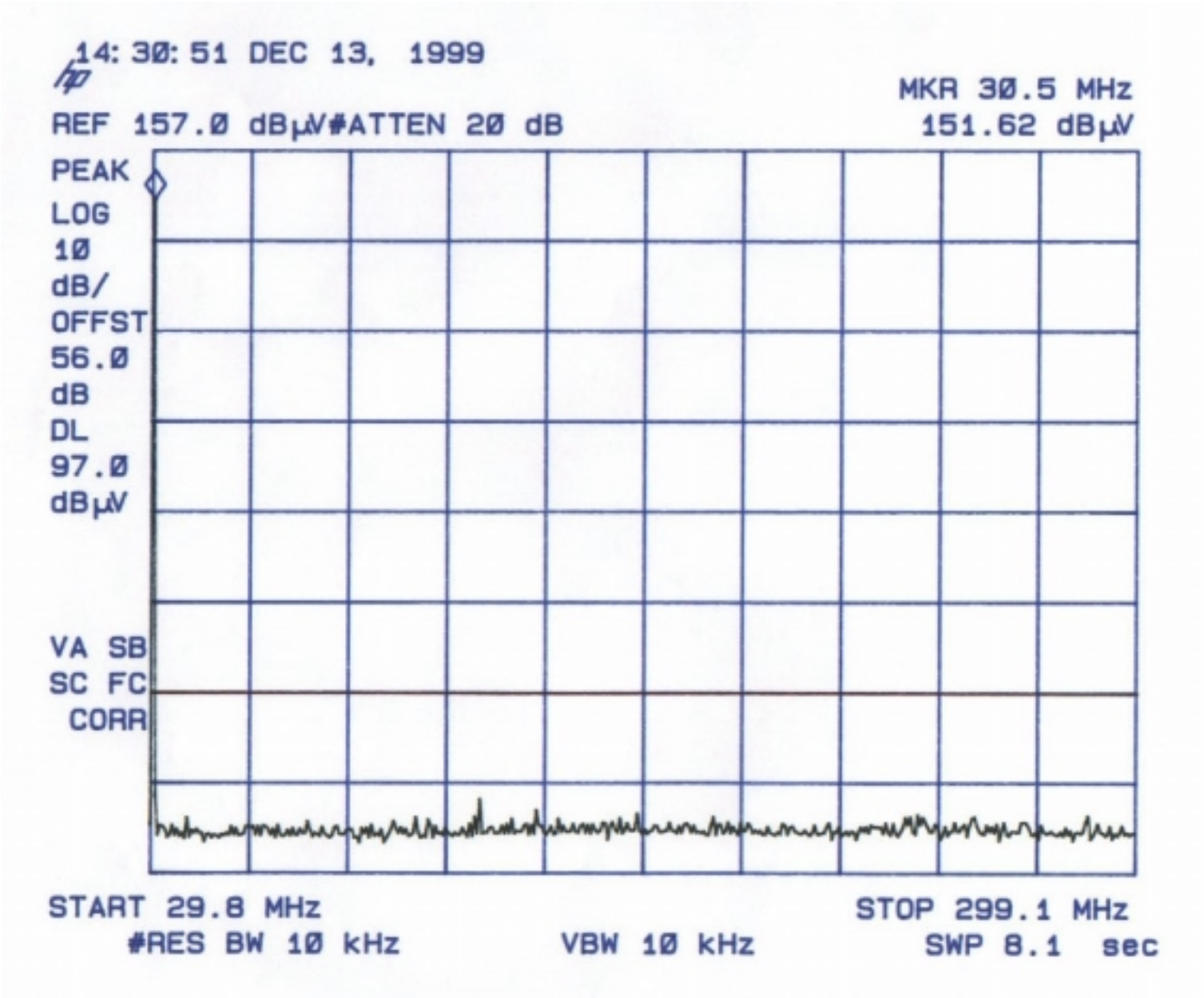

ATTEN 10dB
RL 50.0dBm
10dB/
R
CENTER 1.61000MHz
*RBW 100Hz
*VBW 300Hz
SPAN 20.00KHz
SWP 1.60sec


14: 39: 49 DEC 13, 1999
MKR 1.68 MHz
REF 50.0 dBm #ATTEN 20 dB
48.88 dBm
PEAK
LOG
10
dB/
OFFST
56.0
dB
DL
-10.0
dBm
VA SB
SC FC
CORR
START 1.50 MHz
STOP 16.10 MHz
#RES BW 10 kHz
VBW 10 kHz
SWP 440 msec


ATTEN 10dB
RL 50.0dBm
10dB/
SPAN 20.00KHz
SWP 1.60sec
CENTER 15.60000MHz
*VBW 300Hz
*RBW 100Hz
R


14: 35: 18 DEC 13, 1999
MKR 15.9 MHz
49.15 dBm
REF 50.0 dBm #ATTEN 20 dB
PEAK
LOG
10
dB/
OFFST
56.0
dB
DL
-10.0
dBm
VA SB
SC FC
CORR
START 15.5 MHz
#RES BW 10 kHz
VBW 10 kHz
STOP 156.0 MHz
SWP 4.2 sec


ATTEN 10dB
RL 50.0dBm
10dB/
CENTER 29.91000MHz
SPAN 20.00kHz
*RBW 100Hz
*VBW 300Hz
SWP 1.60sec


14: 30: 51 DEC 13, 1999
MKR 30.5 MHz
REF 157.0 dBµV#ATTEN 20 dB
151.62 dBµV
PEAK
LOG
10
dB/
OFFST
56.0
dB
DL
97.0
dBµV
VA SB
SC FC
CORR
START 29.8 MHz
#RES BW 10 kHz
VBW 10 kHz
STOP 299.1 MHz
SWP 8.1 sec

APPENDIX D

STATEMENT OF MEASUREMENT UNCERTAINTY

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:
A = Antenna calibration uncertainty, in dB = 2 dB
B = Spectrum Analyzer uncertainty, in dB = 1 dB
C = Site uncertainty, in dB = 4 dB
n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.