FCC ID: PQS-BN29001

Exhibit 2d

Engineering Report on Boomer II 900 MHz

Spurious Emissions at Antenna Terminal (2.1051)

Assessment of Compliance

of

Spurious Emissions at Antenna Terminal in accordance with the FCC Rules & Regulations Part 2.1051 and 90

Wireless OEM Modem Module
Boomer II 900 MHz

Wavenet Technologies Pty Ltd.

October 2002

APREL Project No.:WVTB-Boomer II –Modem-3922-2

51 Spectrum Way Nepean ON K2R 1E6
Tel: (613) 820-2730 Fax: (613) 820-4161
email: info@aprel.com

Engineering Report

Subject: **Assessment of Spurious Emissions at Antenna Terminal in accordance with the FCC Rules & Regulations Part 2.1051 and 90**

FCC ID: **PQS-BM29001**

Equipment: **Wireless OEM Modem Module**

Model: **Boomer II 900 MHz**

Client: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Project #: WVTB-Boomer II-Modem-3922-2

Prepared By: **APREL Laboratories**
Regulatory Compliance Division
51 Spectrum Way
Nepean, Ontario
K2R 1E6

Approved by: _____ Date: Oct. 18, 2002
Jay Sarkar
Technical Director, Standards & Certification

Submitted by: _____ Date: Oct. 18, 2002
Jay Sarkar
Technical Director, Standards & Certification

Released by: _____ Date: Oct 18/02
Dr. Jack J. Wojcik, P.Eng.

LICENCED PROFESSIONAL ENGINEER J.J. WOJCIK PROVINCE OF ONTARIO

FCC ID: **PQS-BM29001**
Applicant: Wavenet Technologies Pty Ltd.
Equipment: Wireless OEM Modem Module
Model: **BOOMER II 900 MHz**
Standard: FCC Rules and Regulations Part 2.1051 and 90

ENGINEERING SUMMARY

This report contains the results of the Spurious Emissions at antenna terminal measurement performed on a **Wavenet OEM Wireless Modem Module.** The measurements were carried out in accordance with the FCC Rules and Regulations Part 2.1051 and 90. The product was evaluated for the Spurious Emissions at the Antenna Terminal when it was set at the maximum power level and appropriately modulated.

The Wireless OEM Modem Module is a 900 MHz OEM product for integration into customer end user equipment as an OEM modem and interfaces to it via the data interface port.

This modem has a single profile type with appropriate settings for data rate, deviation, modulation shaping set for 896-901 MHz J Spectral Mask (RDLAP 9.6 kbps).

The test data are given for three channels low, medium and high, (896 MHz, 899 MHz and 901 MHz) and the plots are given for the medium channel 899 MHz.

The results presented in this report relate only to the sample tested.

Table 1: Summary of the Results

Test Description	Page No.	Test Set-up Figure No.	Results Summary
Spurious Emissions at the Antenna Terminal Part 2.1051 and 90	8	1	Pass

INTRODUCTION

General

This report describes the results of the Spurious Emissions at the Antenna Terminal measurement conducted on a Wavenet Technologies Wireless OEM Modem Module model BOOMER II 900 MHz**.**

Test Facility

The evaluation for compliance was performed for Wavenet Technologies Pty Ltd**.** by APREL Laboratories at APREL's EMI facility located in Nepean, Ontario, Canada. The laboratory operates an (3m and 10m) Open Area Test Site (OATS). The measurement facility is calibrated in accordance with ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria per ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. ***APREL's registration number is: 90416***

APREL is accredited by Standard Council of Canada. APREL is also accredited by Industry Canada.

Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Parts 2.1051 and the appropriate limits (90).

Personnel: The test was conducted byY.Chen. Methodology developed and report was written by Jay Sarkar.

Test Equipment

The test equipment used during the evaluation is listed in Appendix A with calibration due dates.

Environmental Conditions

- Temperature:	25 °C ± 2
- Relative Humidity:	30 - 50 %
- Air Pressure:	101 kPa ± 3

FCC SUBMISSION INFORMATION

FCC ID: **PQS-BM29001**

Equipment (Type): **Wireless OEM Modem Module**
As marketed

Model: **BOOMER II 900 MHz**

For: Certification

Applicant: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Manufacturer: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Evaluated by: **APREL Laboratories**
51 Spectrum Way
Nepean, Ontario
Canada K2R 1E6

MANUFACTURER'S DATA

FCC ID No:	**PQS-BM29001**
Equipment Type:	Wireless OEM Modem Module
Model:	BOOMER II 900 MHz
Reference:	FCC Rules and Regulations Parts 2 and Part 90
Manufacturer:	Wavenet Technologies Pty Ltd
Development Stage of Unit:	Prototype

GENERAL SPECIFICATIONS

1.	Frequency Range:	896-901 MHz (Transmitter)
2.	Measured ERP	1.556 W (31.92 dBm)
3.	Emission Designators	Per 47 CFR § 2.201 and §2.202: 9K8F1D
4.	Antenna Impedance:	50 Ohms

Measurement: Spurious Emissions at Antenna Terminal

BOOMER II 900 MHz

Ref.: FCC Part 2.1051 and Part 90.210

Criteria: ***Emission Mask J (896~901MHz).*** The power of emissions must be attenuated below the power of the unmodulated carrier (P) on any frequency removed from the centre of the authorized bandwidth by a displacement frequency (**fd** in kHz) of more than 9.5 kHz: At least 50 + 10 log (P) dB. This is calculated to be –20 dBm.

Set-up: See Figure No. 1.

Methodology:

The BOOMER II 900 MHz was set-up in accordance with the set-up/block diagram Figure no.1. The set–up consisted of the BOOMER II, Spectrum Analyser, Attenuator, and other auxiliary instrumentation necessary to perform the measurements (see Measurement Equipment Lists).
The BOOMER II was configured to operate at maximum power and applicable modulation (4-Level FSK RDLAP 9.6, 2.5 kHz deviation applied to the transmitter as indicated in the plots.

The BOOMER II was coupled to the spectrum analyzer through a short test cable and a 20-dB attenuator connected to the spectrum analyser. Instead of the antenna, an MMCX-M to SMA-F test cable was connected and then from the SMA connector the attenuator was hooked up. From the other side of the attenuator the Spectrum Analyser was directly connected (see block diagram and set-up photograph).

The spectrum was searched from nine kHz to the 10^{th} harmonic of the operating frequency.

Measurements required: Spurious emissions at antenna terminals — The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly terminated with a 50 ohms measurement system.

Spectrum Analyser Set-up - RB: 3kHz, VB: 3kHz, Span: 200kHz.

Data Required: Curves or equivalent data showing the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in paragraph 2.1049 as appropriate.

Not Required: The amplitude of spurious emissions, which are attenuated more than 20 dB below the permissible value.

Frequency Spectrum to be investigated: In all of the spurious emissions measurements of spurious emissions at antenna terminals (2.991) the Spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least to the 10^{th} harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower if the equipment operates below 10 GHz.

If operates below 40 GHz: Since the DUI operated below 10 GHz, the spectrum was searched from 9 kHz to the 10^{th} harmonic of the operating frequency.

Harmonics and sub-harmonics: Particular attention was paid to harmonics and sub-harmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency.

Measurements contain: Measurements shown contain spectrum analyzer reading, correction factor, and final reading. The final spurious emission levels are derived from the analyzer measurement and the correction factor (attenuator, insertion loss of high pass filter and cable loss) as shown in the following example:

Calculation of data: A sample calculation is provided showing the final data obtained from the measured value.

Sample Calculation:

A. Spectrum analyzer reading (Direct measurement)
At 1792 MHz a spurious level of –67.23 dBm is measured.

B. Correction factor: 19.95 dB
C. Spurious Emission Level (Spurious Emissions at Antenna Terminal)

C = A+B = –67.23 dBm + 19.95 dB
C= –47.28 dBm

D. The criteria level is derived from this equation:
P_{TX} is the conducted power of the unmodulated carrier: 1.556 Watts (31.92dBm)

$D = P_{TX} – [50 + (10 \cdot \log P_{TX(W)})]$
D = 31.92dBm – [50 + (10·log 1.556 W)]
D = Criteria (reference) level = -20.0 dBm

E = Margin (spurious emission below the reference level)

E = D - C
E = (-20.0 dBm) – (–47.28 dBm) =27.28 dB

Results: **PASSED.** See Tables 2, 3 and 4 and the plots (shown only for configuration 1).

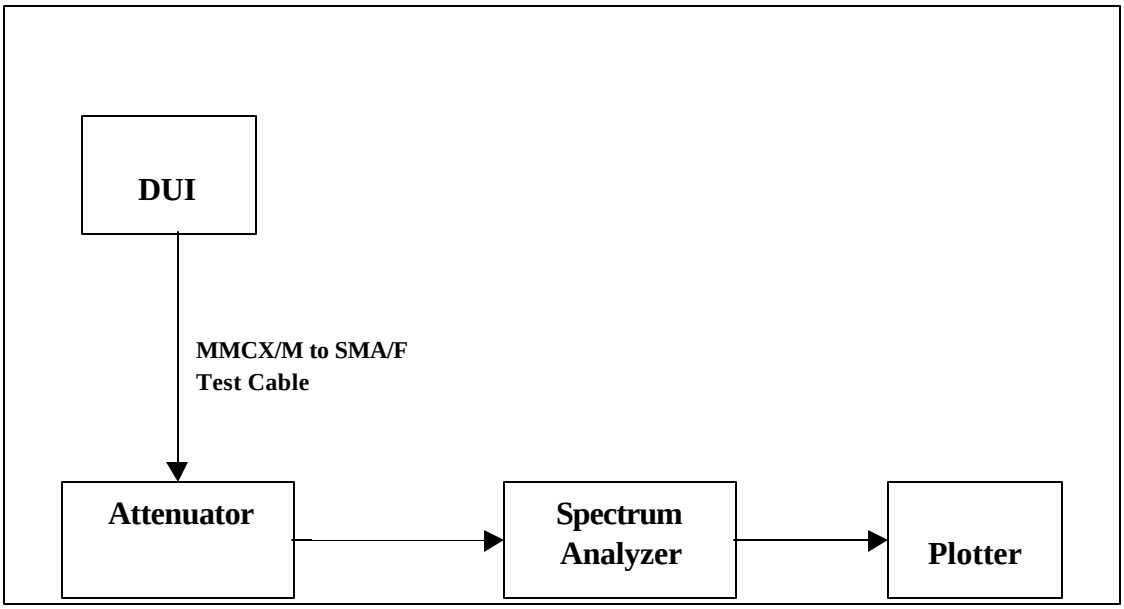


Figure 1: Set Up
Spurious Emissions at Antenna Terminal

MEASUREMENT DATA

Table two
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Spurious Emissions at Antenna Terminal
Fundamental frequency: 896 MHz, Ch. Low

Harmonic No.	Frequency (MHz)	Measured Level (dBm) A	Correction Factor B	Spurious Emission Level (dBm) C	Criteria Level (dBm) D	Margin (dB) E
Fundamental	896	12.02	19.95	31.97	—	—
1	1792	-67.23	19.95	-47.28	-20.00	27.28
2	2688	-72.31	19.95	-52.36	-20.00	32.36
3	3584	-62.13	19.95	-42.18	-20.00	22.18
4	4480	-75.41	19.95	-55.46	-20.00	35.46
5	5376	-75.99	19.95	-56.04	-20.00	36.04
6	6272	-73.97	19.95	-54.02	-20.00	34.02
7	7168	-71.17	19.95	-51.22	-20.00	31.22
8	8064	-74.83	19.95	-54.88	-20.00	34.88
9	8960	-71.69	19.95	-51.74	-20.00	31.74
10	9856	-73.50	19.95	-53.55	-20.00	33.55

C=A+B, E=D-C

MEASUREMENT DATA

Table three
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Spurious Emissions at Antenna Terminal
Fundamental frequency: 899 MHz, Ch. Medium

Harmonic No.	Frequency (MHz)	Measured Level (dBm) A	Correction Factor B	Spurious Emission Level (dBm) C	Criteria Level (dBm) D	Margin (dB) E
Fundamental	899	12.09	19.95	32.04	—	—
1	1798	-67.48	19.95	-47.53	-20.00	27.53
2	2697	-74.56	19.95	-54.61	-20.00	34.61
3	3596	-60.26	19.95	-40.31	-20.00	20.31
4	4495	-74.24	19.95	-54.29	-20.00	34.29
5	5394	-76.75	19.95	-56.80	-20.00	36.80
6	6293	-72.72	19.95	-52.77	-20.00	32.77
7	7192	-72.46	19.95	-52.51	-20.00	32.51
8	8091	-78.37	19.95	-58.42	-20.00	38.42
9	8990	-73.00	19.95	-53.05	-20.00	33.05
10	9889	-73.63	19.95	-53.68	-20.00	33.68

C=A+B, E=D-C

MEASUREMENT DATA

Table four
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Spurious Emissions at Antenna Terminal
Fundamental frequency: 901 MHz, Ch. High

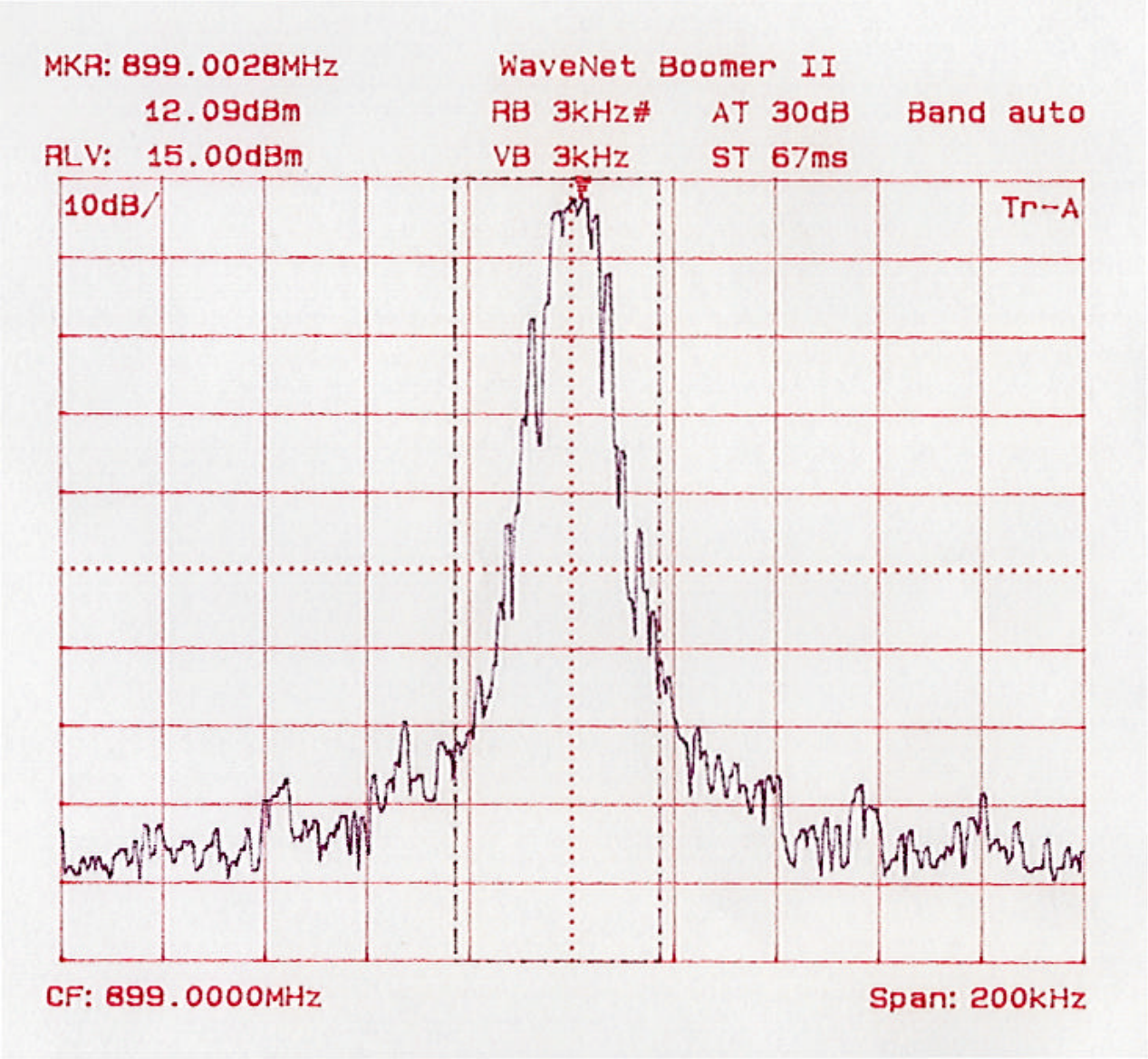
Harmonic No.	Frequency (MHz)	Measured Level (dBm) A	Correction Factor B	Spurious Emission Level (dBm) C	Criteria Level (dBm) D	Margin (dB) E
Fundamental	901	11.23	19.95	31.18	—	—
1	1802	-67.21	19.95	-47.26	-20.00	27.26
2	2703	-73.28	19.95	-53.33	-20.00	33.33
3	3064	-60.34	19.95	-40.39	-20.00	20.39
4	4505	-75.08	19.95	-55.13	-20.00	35.13
5	5406	-75.92	19.95	-55.97	-20.00	35.97
6	6307	-72.64	19.95	-52.69	-20.00	32.69
7	7208	-72.15	19.95	-52.20	-20.00	32.20
8	8109	-76.27	19.95	-56.32	-20.00	36.32
9	9010	-72.56	19.95	-52.61	-20.00	32.61
10	9911	-73.89	19.95	-53.94	-20.00	33.94

C=A+B, E=D-C

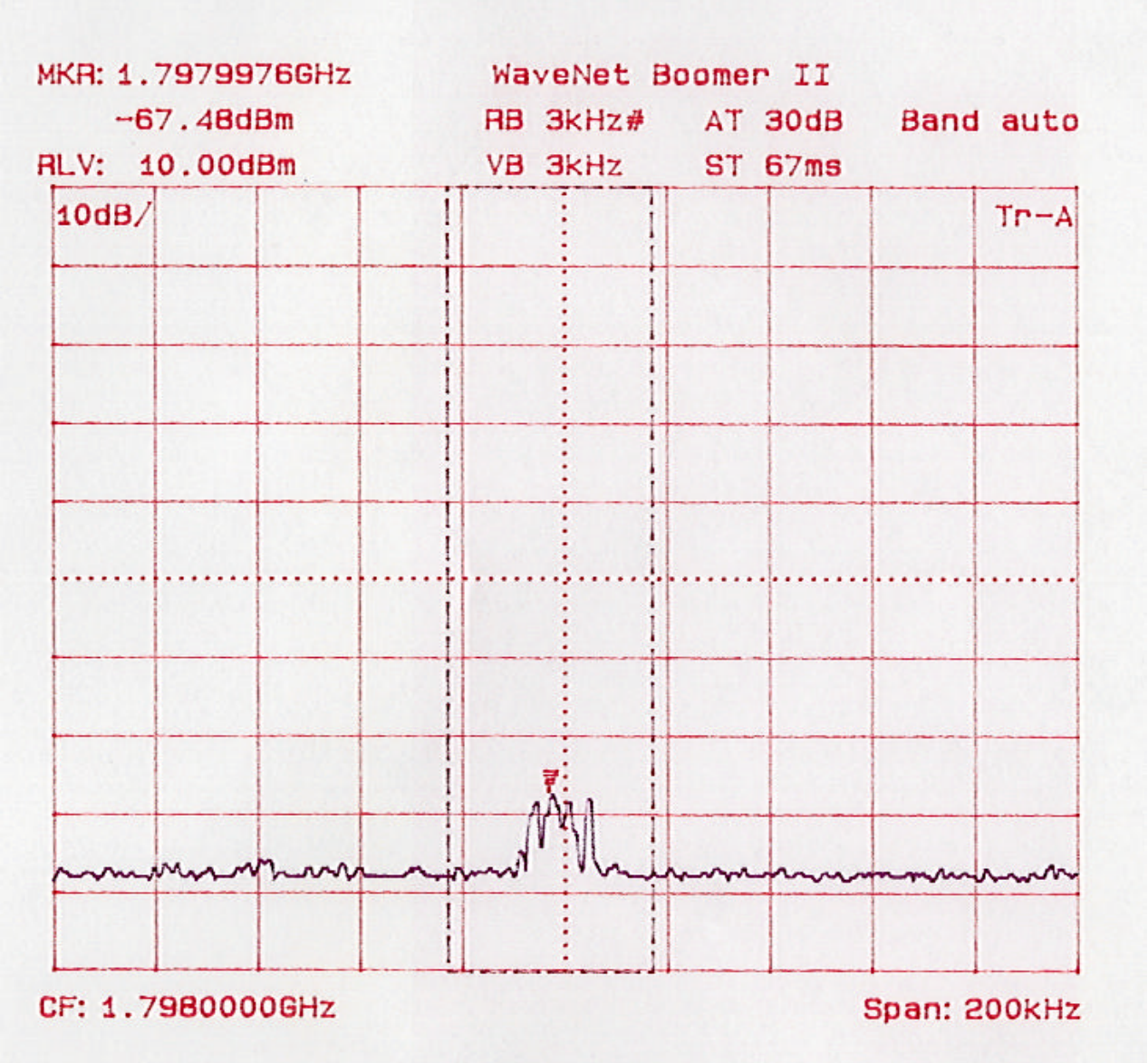
Test performed by: Yinghui Chen Date: Oct. 2002

BOOMER II 900 MHz

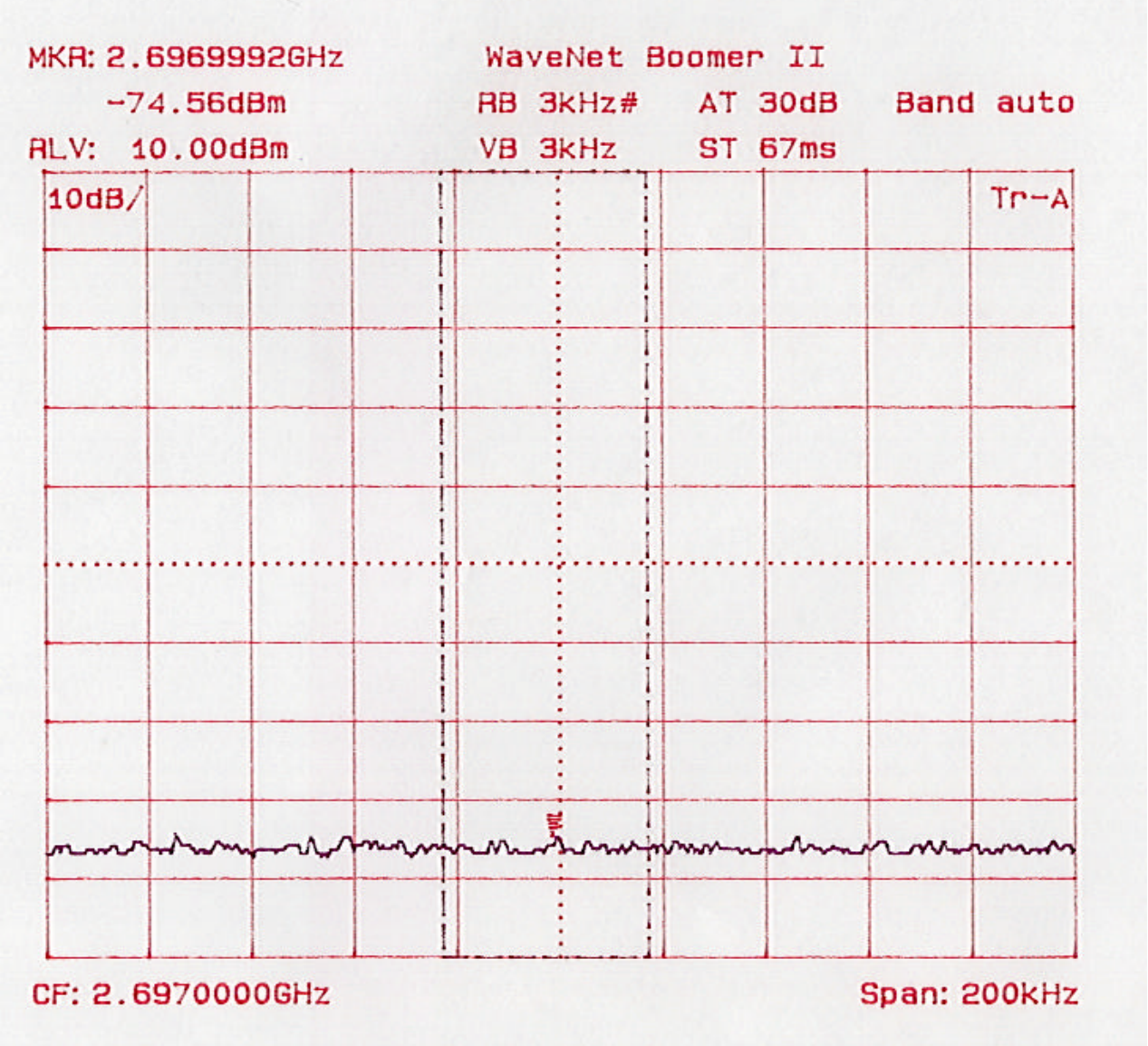
Spurious Emissions
at Antenna Terminal - Plots
896-901 MHz
Mask J
RDLAP 9.6 kbps
Fundamental Frequency: 899 MHz, Ch. Medium



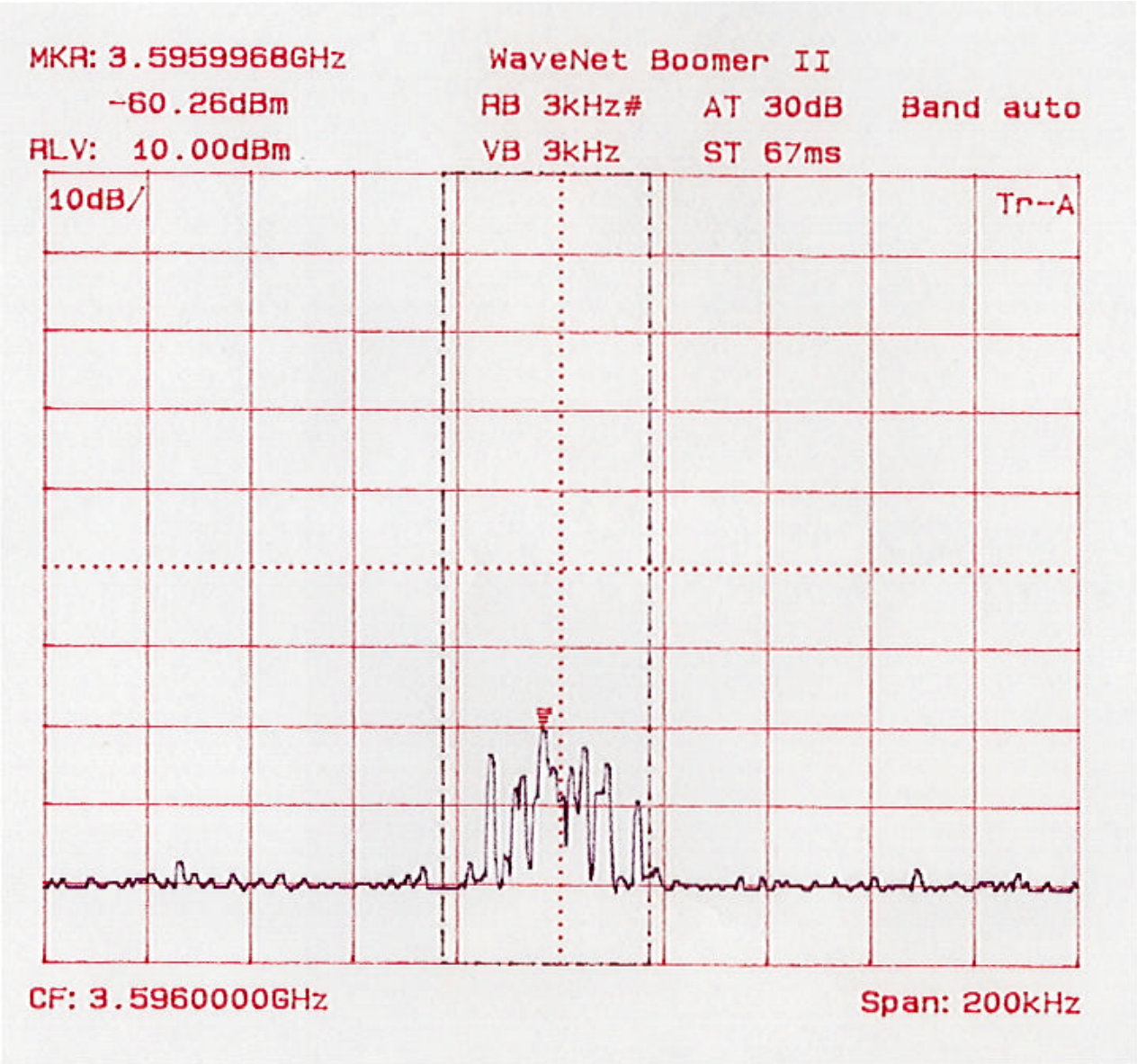
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, fundamental frequency



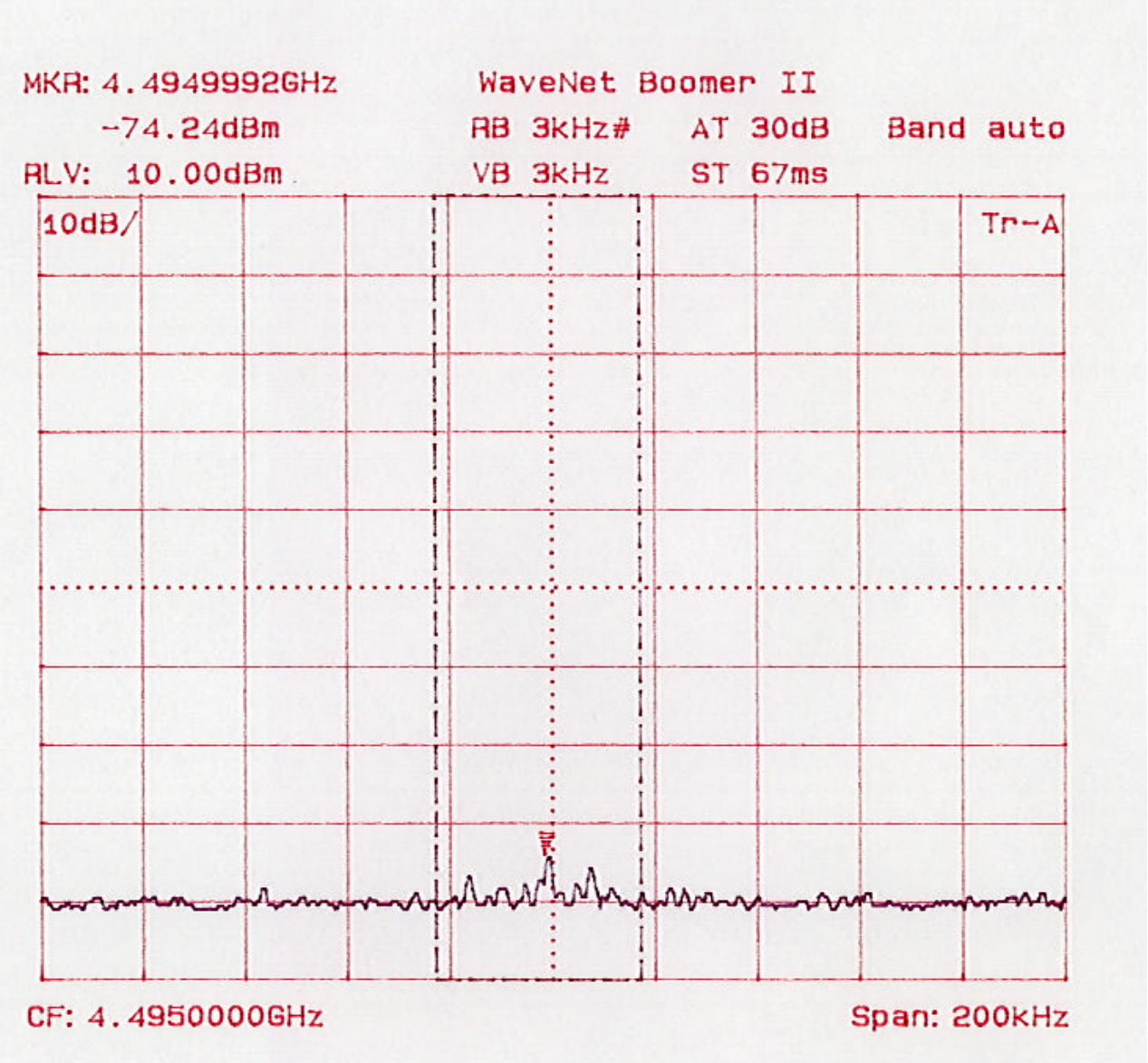
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 1st harmonic, 1798 MHz



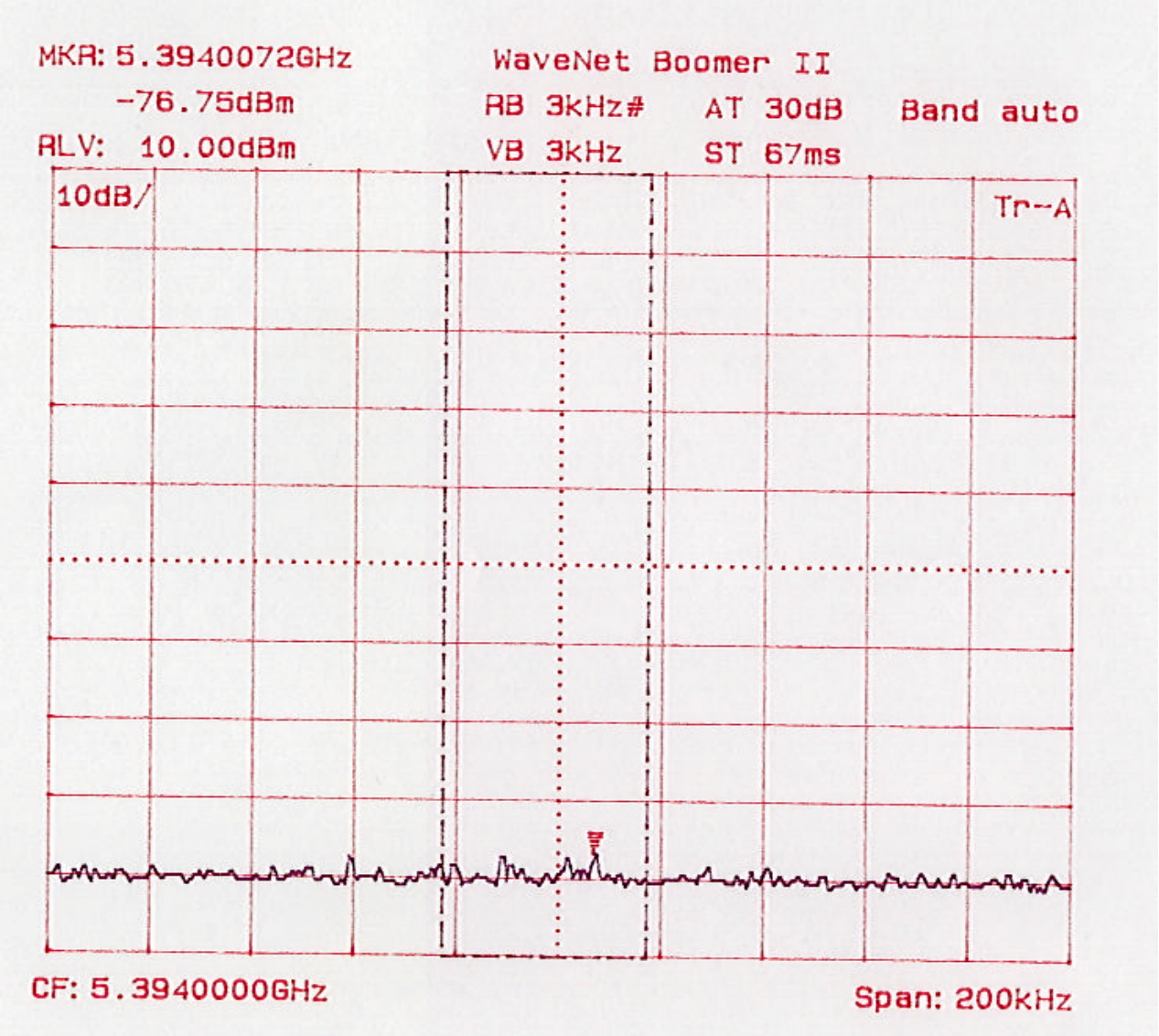
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 2nd harmonic, 2697 MHz



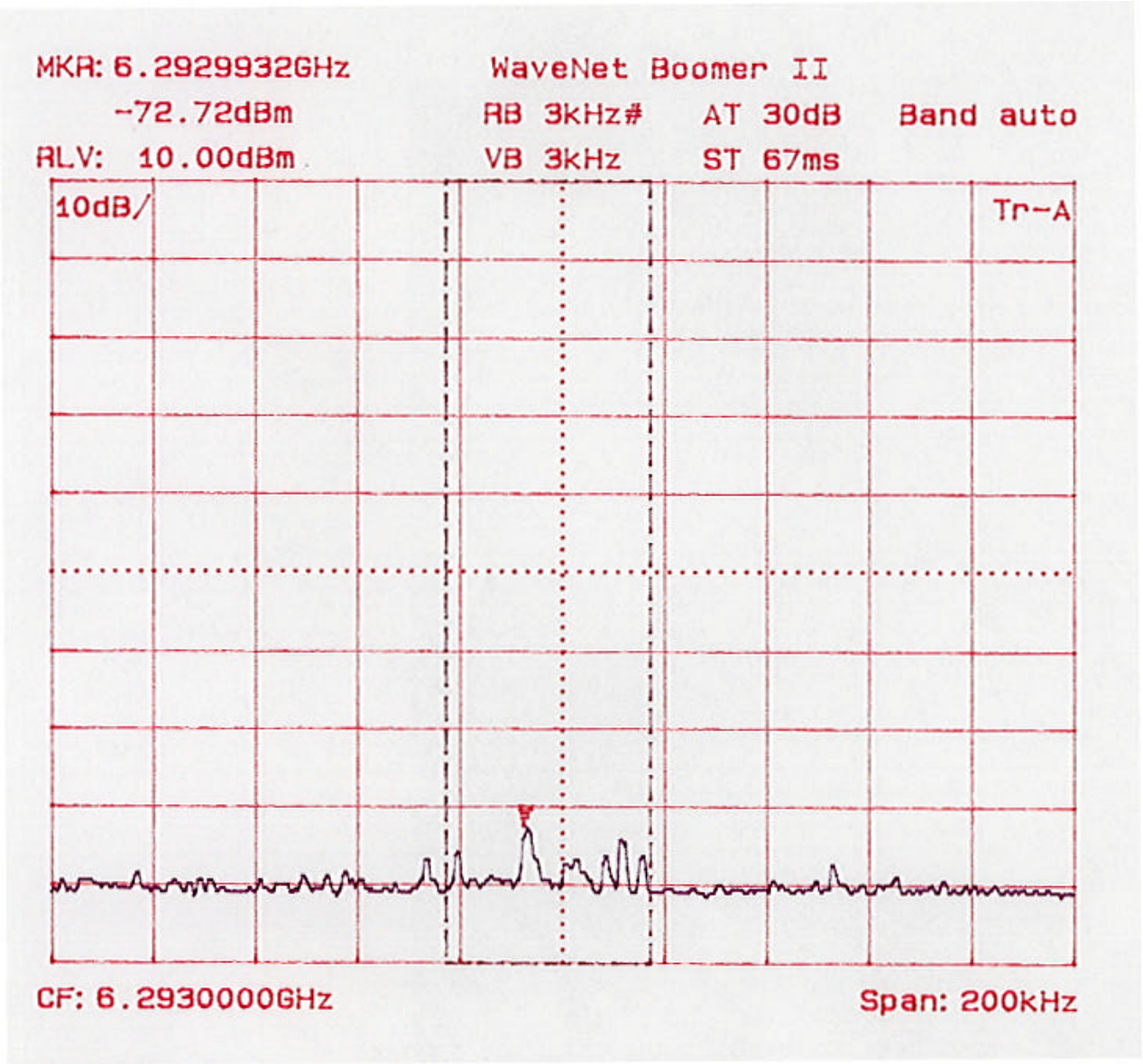
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 3rd harmonic, 3596 MHz



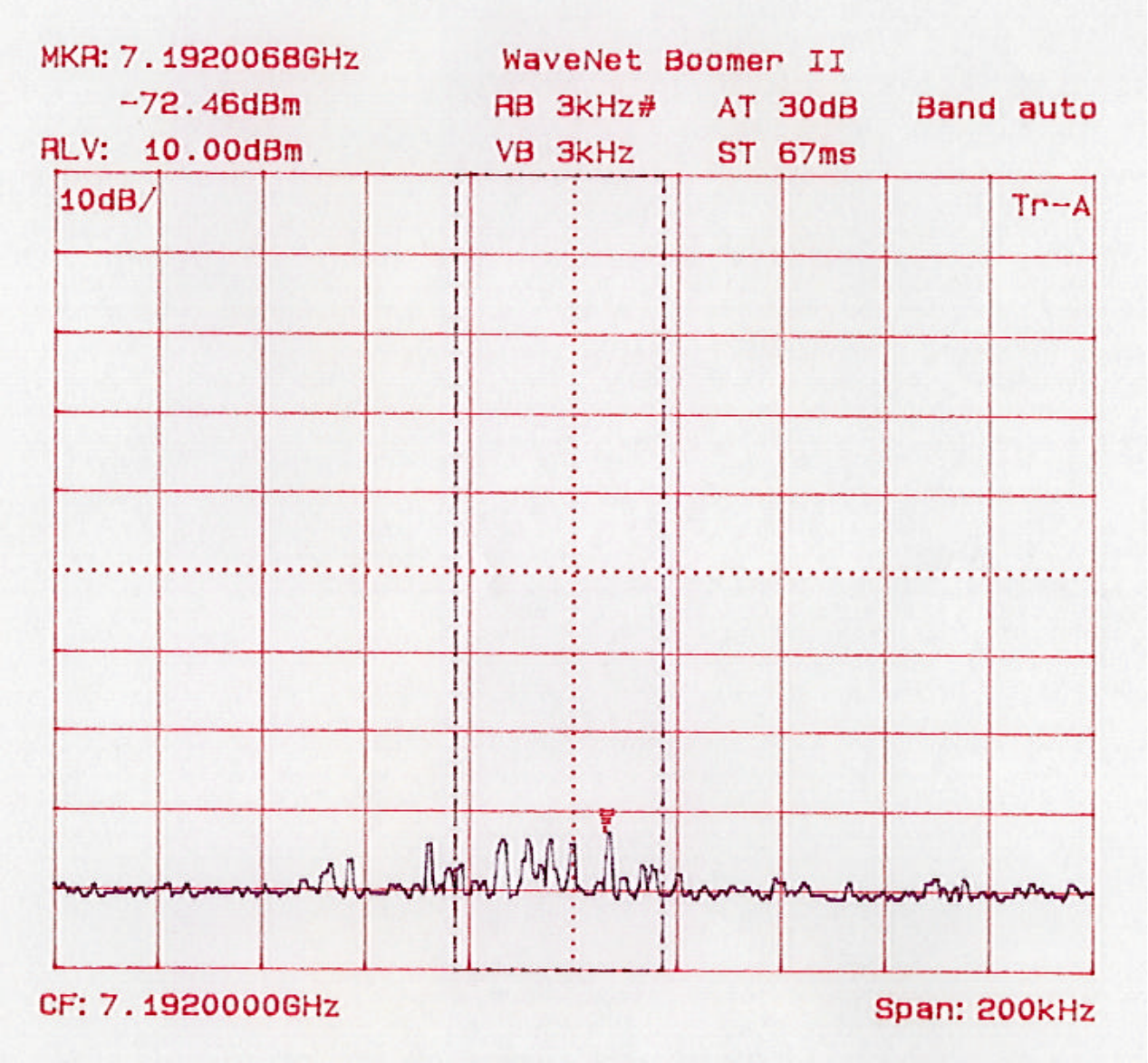
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 4th harmonic, 4495 MHz



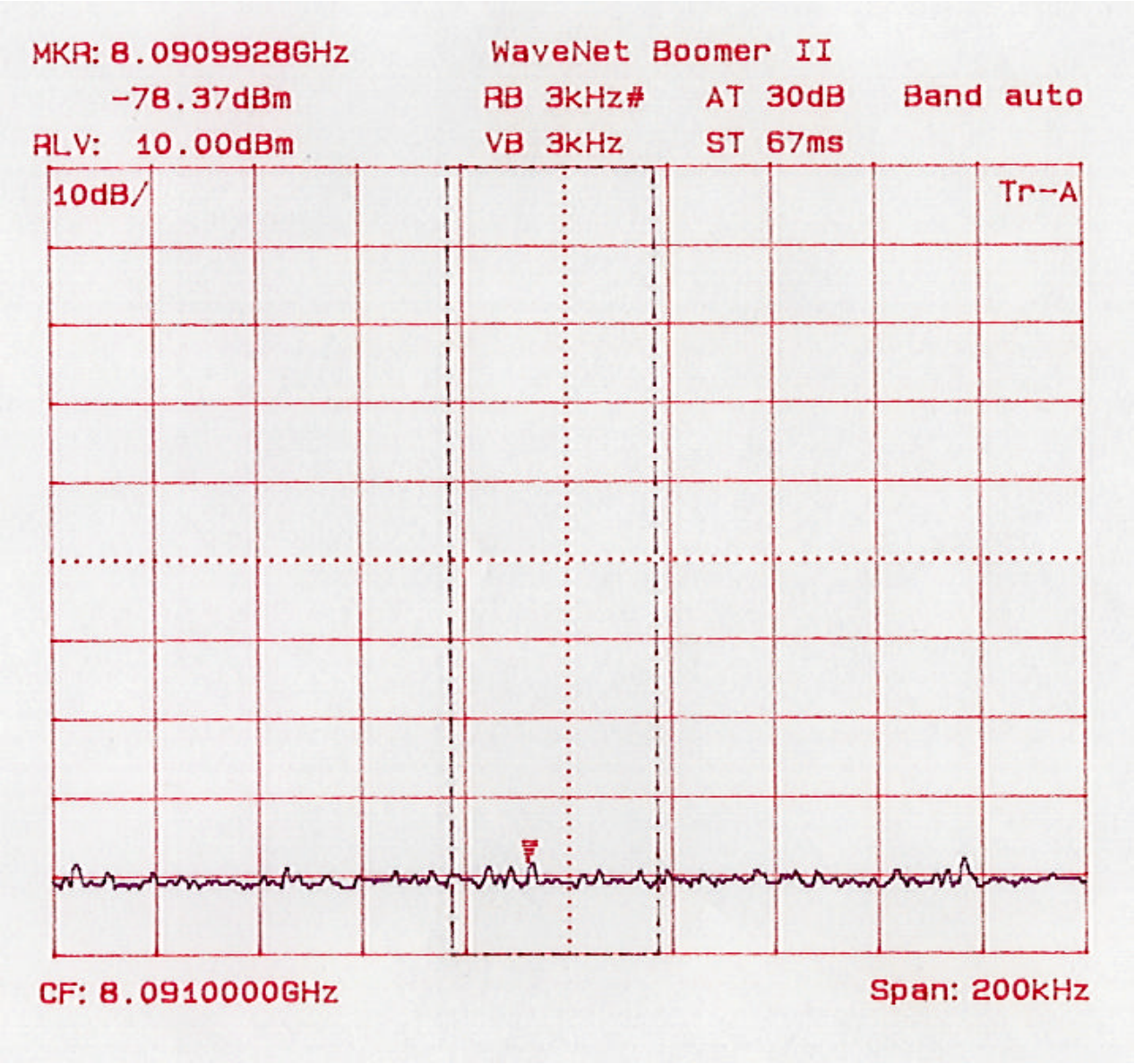
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 5th harmonic, 5394 MHz



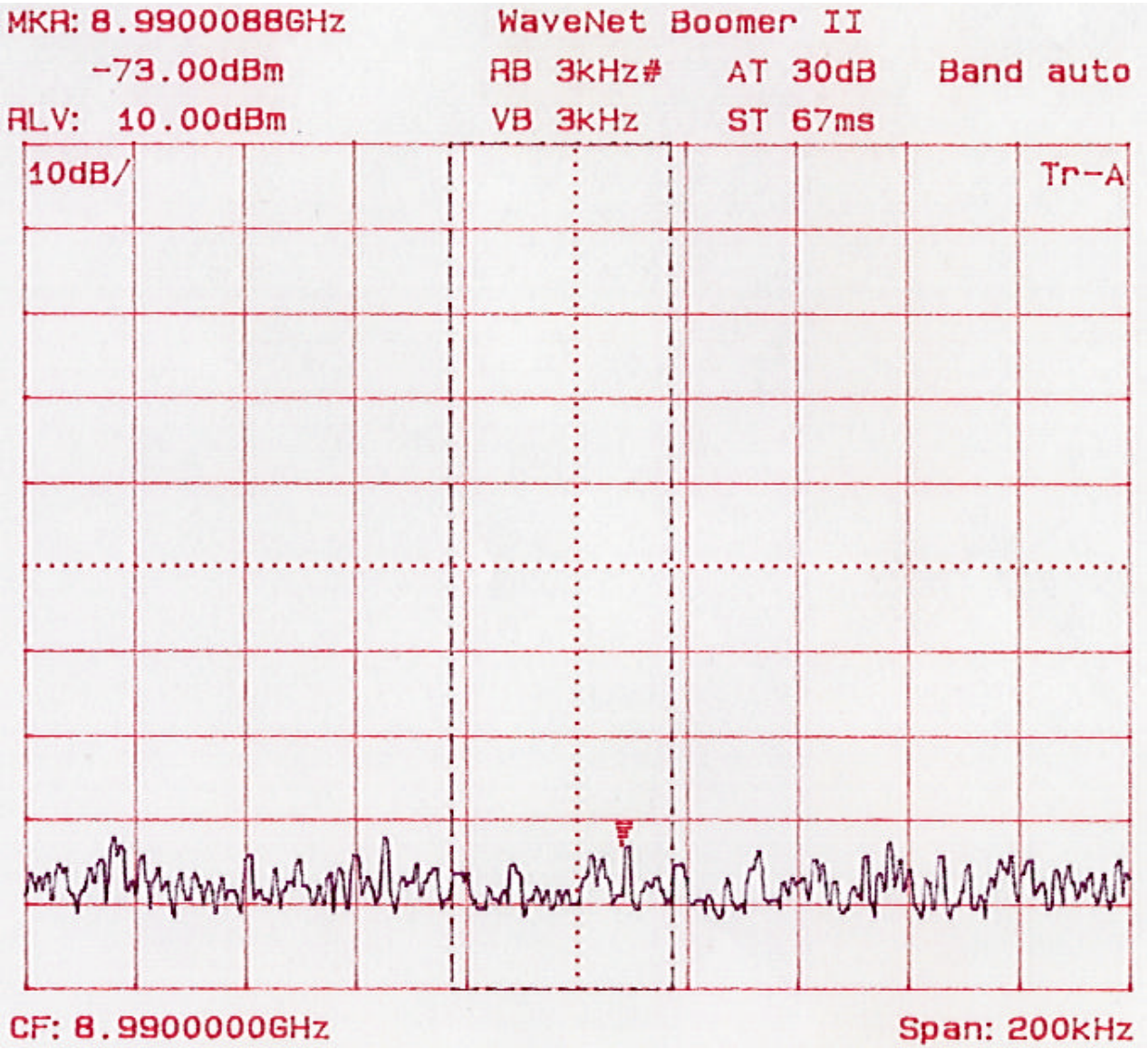
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 6th harmonic, 6293 MHz



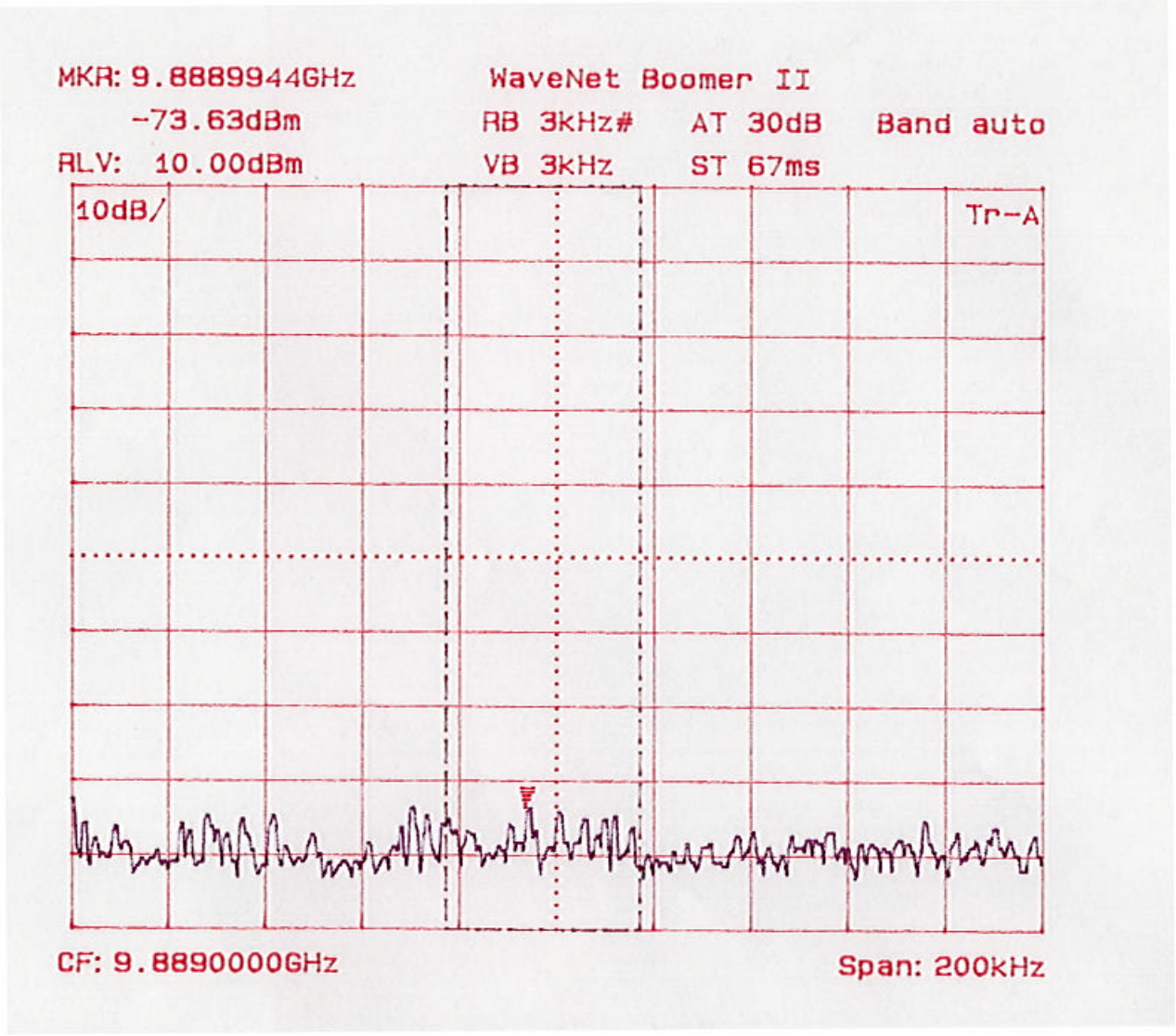
WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 7th harmonic, 7192 MHz



WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 8th harmonic, 8091 MHz



WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 9th harmonic, 8990 MHz



WaveNet Boomer II 900 MHz
Spurious Emissions from Transmitter @ Antenna Terminal
Channel: Medium, 899 MHz
Modulation: RDLAP 9.6 kbps, Mask J, 10th harmonic, 9889 MHz

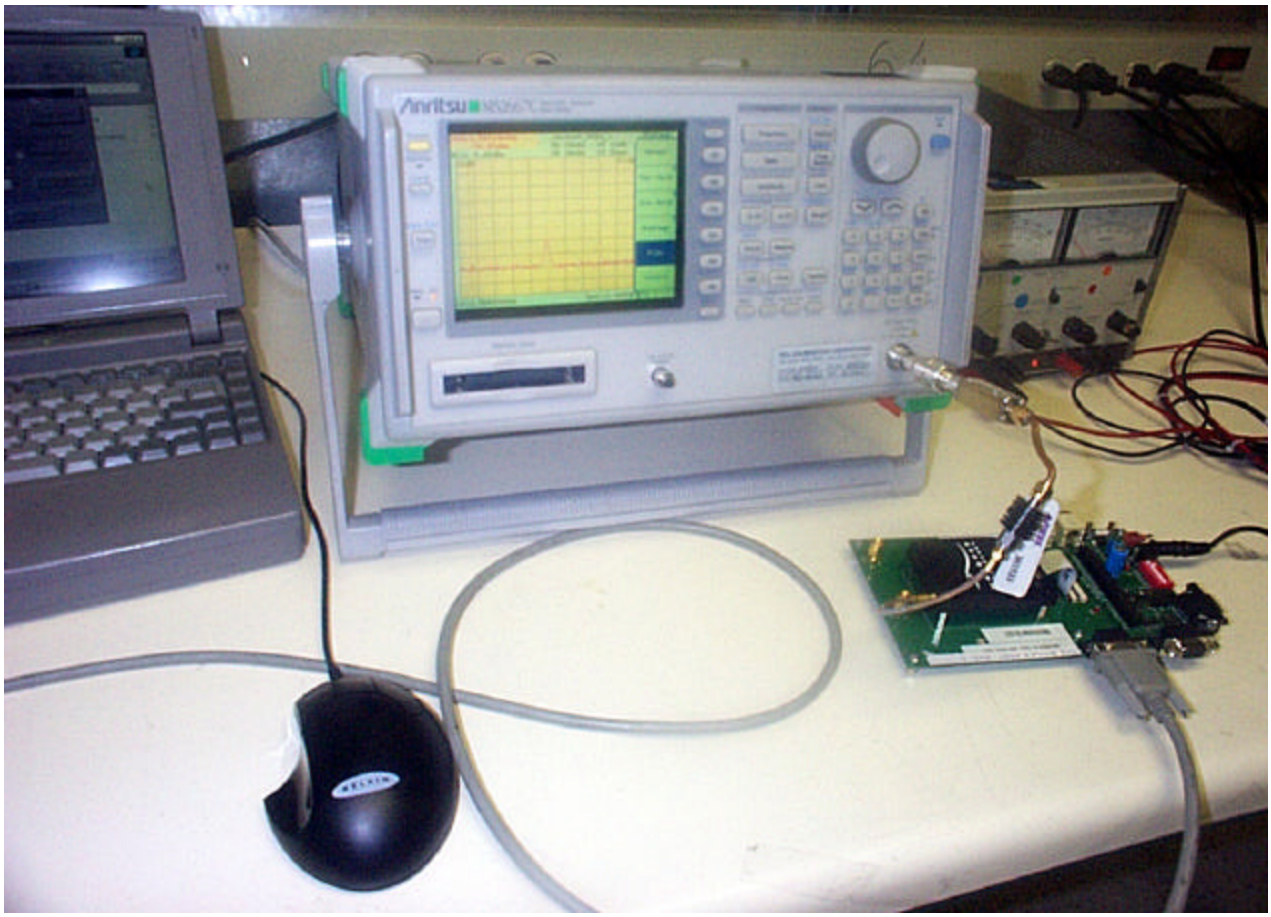
APPENDIX A
TESTING EQUIPMENT

List of Equipment used

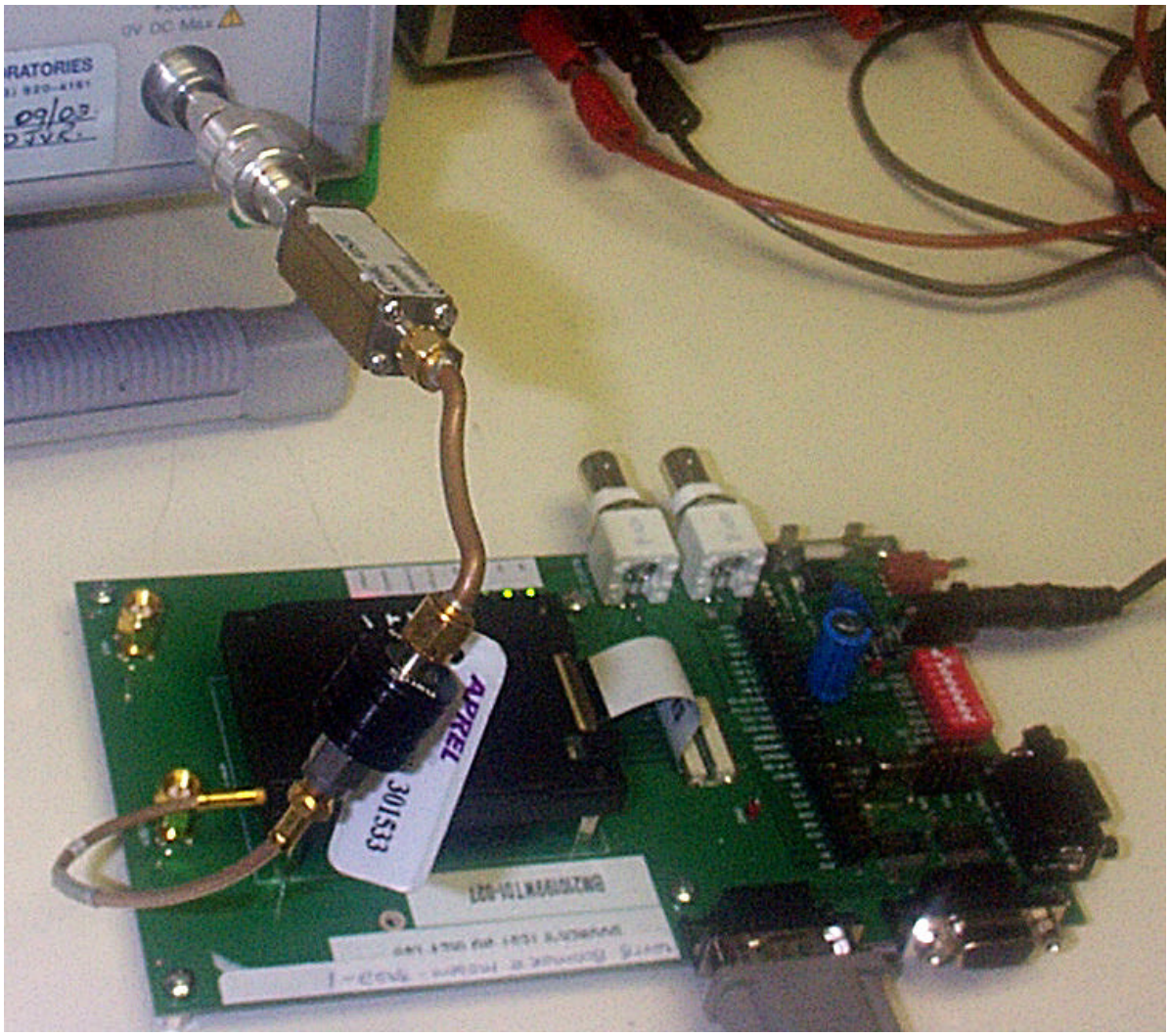
Description	Manufacturer	Model #	Asset #	Calibration Due Data
Spectrum Analyzer	Anritsu	MS2667C	301386	Sept. 5, 2003
High Pass Filter	—	KPMC 035J0	301560	Aug. 15, 2003
Power Meter	HP	HP438A	301417	Sept. 5, 2003
Attenuator	Narda	4774-20	301533	Oct. 15, 2003

APPENDIX B
PHOTOGRAPHS

Wireless OEM Modem Module
WaveNet BOOMER-II
900 MHz



Testing Spurious Radiation from Transmitter @ Antenna Port
on WaveNet BOOMER-II Wireless Modem
900 MHz



Testing Spurious Emissions from Transmitter @ Antenna Port
on WaveNet BOOMER-II Wireless Modem
900 MHz