FCC CERTIFICATION REPORT

for

Hughes Network Systems
11717 Exploration Lane
Germantown, MD 20876

FCC ID: K3Y30025140-40

May 11, 1998

WLL PROJECT #: 4442X

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TABLE OF CONTENTS

Statement of Qualifications

TABLES

STATEMENT OF QUALIFICATIONS

for

Steven Koster

Washington Laboratories, Ltd.

I have eighteen years of electronics experience, the last seven 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: Steven Koster
EMC Laboratory Manager

Date: 5/11/98

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FCC ID: K3Y30025140-40

1.0 Introduction

This report has been prepared on behalf of Hughes Network Systems to support the attached Application for Equipment Authorization. The test and application are submitted for an approval under the following FCC requirements:

1. Class B Digital Device under Part 15 of the FCC Rules and Regulations.
2. TV Interface Device under Part 15 of the FCC Rules and Regulations.
3. Radio Receiver (Superheterodyne) under Part 15 of the FCC Rules and Regulations.

The equipment under test was the Hughes Network Systems DirecPC Enterprise Relay.

All measurements herein were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are 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, Ltd. has been approved by the FCC and NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent test laboratory.

All results report 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.

1.1 Summary

The Hughes Network Systems DirecPC Enterprise Relay complies with the following FCC requirements:

1. Class B Digital Device under Part 15 of the FCC Rules and Regulations.
2. TV Interface Device under Part 15 of the FCC Rules and Regulations.
3. Radio Receiver (Superheterodyne) under Part 15 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The DirecPC Enterprise Relay is part of an Integrated Satellite Business Network (ISBN) which is a private, two-way transmission system for data traffic. All ISBN traffic is carried between a large master station, called the hub, and small, remote Personal Earth Stations (PES's). The two-way data transmissions are relayed between the hub and the PES via a geosynchronous communications satellite located over the equator. The ISBN can also distribute one-way television video and audio from the hub to remote television receivers at the remote PES.

Advanced network control processing at the hub supports and controls the operation of the PES equipment. Under normal conditions, manual operation of the PES is not required.

There are two configurations for the DirecPC Enterprise Edition Integrated Relay. The first configuration which is designed for commercial use, consists of a PES 5000 (FCC Class A device) coupled with the DirecPC Enterprise Edition Integrated Relay. This configuration provides a two-way data interface along with a one-way audio and video interface. The second configuration which is designed for commercial or residential use, combines the DirecPC Enterprise Edition Integrated Relay with a DirecPC antenna and LNB. This configuration provides unidirectional data, audio, and video services.

The unit contains a 950-2150 satellite receiver, a Channel 3/4 video modulator, a computer network interface, a computer serial interface, and a television interface.

The AC powered unit contains the following I/O connectors:

- 3 "F" type coaxial connectors for input from the satellite, input from the antenna, and output to the TV
- 3 RCA jacks for baseband audio and video output
- Mini-DIN connector for S-Video input
- DB-9 connector for RS-232 interface
- 2 RJ-45 connectors for 10BaseT computer network interface
- A modular connector for debug of the system (not connected during "normal" operation)

2.1 On-board Oscillators

The DirecPC Enterprise Relay contains a 13.5 MHz, 10.0 MHz, 66 MHz, 20 MHz, and 4.5 MHz oscillator\crystal.

3.0 Test Configuration

To complete the minimum test configuration required by the FCC, the satellite input port was connected to a DirecPC satellite dish; the antenna input port was connected to a VCR; the TV output port, S-video port, and baseband audio and video ports were connected to a television; the 10BaseT ports were connected, via a network hub, to two different FCC approved network cards that were installed in a FCC approved host PC; and the serial port was connected to the host PC. The host PC was also configured with FCC approved peripherals.

3.1 Testing Algorithm

A receive link was established using an the DirecPC satellite dish. A satellite signal was locked in the DirecPC Enterprise Relay commanded to receive the audio and video information. A host personal computer was connected via an RS-232 link to the DirecPC Enterprise Relay unit to continuously monitor the state of the satellite downlink and provide an active data link between the DirecPC Enterprise Relay and the host PC. Data was also continuously sent from the network cards to the EUT.

3.2 Conducted Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table. Power to the EUT was provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 450 kHz to 30 MHz was measured. The detector function was set to quasi-peak or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

Table 1

FCC Class B Conducted Emissions Data - Site 2

CLIENT: Hughes Network Systems
FCC ID: K3Y30025140-40
DATE: 4/6/98
BY: Steve Koster
JOB #: 4440B

LINE 1 - NEUTRAL

FREQUENCY MHz	VOLTAGE (PEAK) dBuV	VOLTAGE uV	FCC LIMIT uV	MARGIN dB
1.04	32.4	41.7	250	-15.6
5.00	36.4	66.1	250	-11.6
5.89	43.2	144.5	250	-4.8
5.95	40.6	107.2	250	-7.4
6.12	38.0	79.4	250	-10.0
9.64	36.7	68.4	250	-11.3

LINE 2 - PHASE

FREQUENCY MHz	VOLTAGE (PEAK) dBuV	VOLTAGE uV	FCC LIMIT uV	MARGIN dB
1.14	34.4	52.5	250	-13.6
3.56	36.8	69.2	250	-11.2
5.82	38.3	82.2	250	-9.7
5.95	38.4	83.2	250	-9.6
6.09	38.1	80.4	250	-9.9
9.54	34.0	50.1	250	-14.0

3.3 Radiated Emissions Testing

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. A Biconical Log Periodic broadband antenna was 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 peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. The measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, 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 2. 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: EdBμV/m = VdBμV + AFcdB/m

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

Data is recorded in Table 2.

Table 2

FCC Class B 3M Radiated Emissions Data - Site 2

CLIENT: Hughes Network Systems
FCC ID: K3Y30025140-40
DATE: 5/8/98
BY: Steve Koster
JOB #: 4440B

FREQ MHz	POL H/V	Azimuth Degree	Ant Height m	SA LEVEL (QP) dBuV	AFc dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MARGIN dB
80.00	V	0.00	1.0	21.9	9.0	30.9	35.2	100.0	-9.1
110.65	H	90.00	2.3	8.2	12.5	20.7	10.9	150.0	-22.8
132.00	H	180.00	3.0	12.8	11.6	24.4	16.6	150.0	-19.1
181.25	H	315.00	2.3	10.8	10.9	21.7	12.1	150.0	-21.8
195.24	H	270.00	2.0	13.1	11.9	25.0	17.7	150.0	-18.6
198.00	V	0.00	1.0	8.5	12.0	20.5	10.6	150.0	-23.0
199.74	V	180.00	1.0	16.7	12.2	28.9	27.7	150.0	-14.7
228.85	H	270.00	2.5	15.4	14.2	29.6	30.3	200.0	-16.4
231.00	H	180.00	1.0	10.5	14.2	24.7	17.3	200.0	-21.3
244.03	H	292.50	2.0	9.4	14.3	23.7	15.4	200.0	-22.3
250.56	H	292.50	1.0	16.5	14.4	30.9	35.2	200.0	-15.1
263.00	H	180.00	1.0	24.1	14.9	39.0	88.7	200.0	-7.1
264.00	V	315.00	1.0	24.3	14.9	39.2	91.1	200.0	-6.8
276.63	H	180.00	1.0	10.9	15.3	26.2	20.5	200.0	-19.8
297.00	V	315.00	1.0	18.1	16.0	34.1	50.4	200.0	-12.0
313.36	H	90.00	1.0	6.6	16.4	23.0	14.2	200.0	-23.0
324.03	H	180.00	1.0	8.7	16.7	25.4	18.7	200.0	-20.6
350.80	H	180.00	1.0	19.0	17.5	36.5	66.5	200.0	-9.6
594.00	V	0.00	1.0	8.9	23.3	32.2	40.9	200.0	-13.8
621.06	V	135.00	1.0	13.0	23.9	36.9	70.2	200.0	-9.1
627.02	V	315.00	1.0	10.5	24.1	34.6	53.4	200.0	-11.5
660.00	V	0.00	1.0	12.2	24.7	36.9	70.2	200.0	-9.1
792.00	V	202.50	1.0	11.0	27.1	38.1	80.5	200.0	-7.9
918.04	V	202.50	1.0	9.6	28.4	38.0	79.1	200.0	-8.1

Note: No emissions were detected above 1 GHz.

4.0 TV Interface Device Test Configuration

Testing was performed per the applicable limits under FCC Part 15.115 and under the procedure specified in ANSI C63.4:1992. This section documents the procedure required for determining conformance with the requirement.

4.1 Output and Spurious Conducted Data TV Interface Devices

The DirecPC Enterprise Relay was connected to the satellite dish (via the "IFL" cable). The broadcast antenna port was terminated in a 75 ohm impedance.

The modulated output to the television (Channels 3 and 4) were measured via a 50 ohm to 75 ohm matching transformer on the input to the spectrum analyzer.

The following signals were measured:

Channel 3: Video Carrier @ 61.25 MHz
Audio Carrier #1 @ 56.757 MHz
Audio Carrier #2 @ 65.75 MHz

Channel 4: Video Carrier @ 67.237 MHz
Audio Carrier #1 @ 62.743 MHz
Audio Carrier #2 @ 71.733 MHz

The Channel 3 and 4 output of the Hughes Network Systems DirecPC Enterprise Relay complies with the requirements of FCC Part 15.115.

Per the requirements of ANSI C63.4 (Section 10.1.8.4) the remainder of the spectrum around the carrier frequencies were measured as follows:

In the bands: 30 MHz to 4.6 MHz below the video carrier and
In the bands: 7.4 MHz above the video carrier to 1 GHz

No significant emissions were found in the above bands.

Data are presented in Table 3. Spurious emission plots for Channels 3 and 4 are provided in Appendix A and B. respectively.

4.2 Antenna Transfer Switch Measurements

In accordance with 10.1.8.5 of ANSI C63.4, the antenna transfer switch characteristics of the Hughes Network Systems DirecPC Enterprise Relay were measured.

The Hughes Network Systems DirecPC Enterprise Relay was installed on a non-conductive table of 80 cm in height. The DirecPC Enterprise Relay was connected to the satellite dish via the "IFL" cable, which provides a frequency of between 950 MHz - 1450 MHz to the DirecPC Enterprise Relay tuner. The output to the television was terminated in a 75 ohm impedance. The conducted voltage at the broadcast antenna input was measured for Channels 3 and 4.

An antenna was then connected to the broadcast input port and the conducted voltage on the IFL/satellite input port was measured for Channels 3 and 4.

In each case, the measurements were obtained via a 75 ohm-to-50 ohm matching transformer.

Data are provided in Table 3 of this report.

Table 3

FCC Class B TV Interface Data
Per Section 15.115

CLIENT: Hughes Network Systems
FCC ID: K3Y30025140-40
DATE: 3/10/98
BY: Steve Koster
JOB #: 4442X

Channel 3	Frequency MHz	Level uV	Limit uV	Margin dB	
Video Carrier	61.25	1316.60	3000.0	-7.2	
Audio Carrier #1	56.757	213.53	671.0	-9.9	
Audio Carrier #2	65.75	206.28	671.0	-10.2	
Spurious Emissions	See Plots				
Transfer Switch (@ IFL Port)	61.25	1.49	30.0	-26.1	
Transfer Switch (@ Over-the Air Port)	61.26	0.88	30.0	-30.7	Noise Floor

Channel 4	Frequency MHz	Level uV	Limit uV	Margin dB	
Video Carrier	67.237	1228.70	3000.0	-7.8	
Audio Carrier #1	62.743	190.31	671.0	-10.9	
Audio Carrier #2	71.733	185.98	671.0	-11.1	
Spurious Emissions	See Plots				
Transfer Switch (@ IFL Port)	67.237	1.59	30.0	-25.5	
Transfer Switch (@ Over-the Air Port)	67.237	0.88	30.0	-30.7	Noise Floor

Table 4

System Under Test

FCC ID: K3Y30025140-40

EUT:	Hughes Network Systems DirecPC Enterprise Relay; FCC ID: K3Y30025140-40
Host PC:	Hewlett-Packard; M/N: N/A; S/N: US72653503; FCC ID: B94VECTRAVAMI
Network Card:	3Com; M/N: 3C905-TX; S/N: 6HH1D4F88A; FCC ID: DF63C905-TX
Network Card:	Intel; M/N: N/A; S/N: 00A0C98D810637713; FCC ID: EJMNPDSPD035
Monitor:	CTX; M/N: VL400; S/N: 191-72407710; FCC ID: DBL1451E
Keyboard:	Hewlett-Packard; M/N: E03633YLUS-C; FCC ID: CIGE03633
Mouse:	Hewlett-Packard; M/N: N/A; S/N: LZA71560748; FCC ID: DZL211029
Television:	Sony; M/N: KV-20V50; S/N: 8123879
VCR:	GE; M/N: VG2058; S/N: 630357131; FCC ID: C5F7NF0003
Network Hub:	Linksys; M/N: EW5HUB; S/N: 802000679; FCC ID: KFYPEH5
Network Hub:	Kingston; M/N: EtherRX; S/N: 7030000081; FCC ID: JICKNE8TP-HO

Table 5

Interface Cables Used

One meter bundled/shielded interface cables were used throughout the system, except for the S-video, 10BaseT, and RCA cables which were non-shielded.

The Hughes Network Systems DirecPC Enterprise Relay was powered via a permanently attached non-shielded AC power cord.

Table 6

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP 8568B

Hewlett-Packard Signal Generator: HP 8656B

Hewlett-Packard Quasi-Peak Adapter: HP 85650A

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A

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

AH Systems, Inc. Antenna Tripod: ATU-200/510

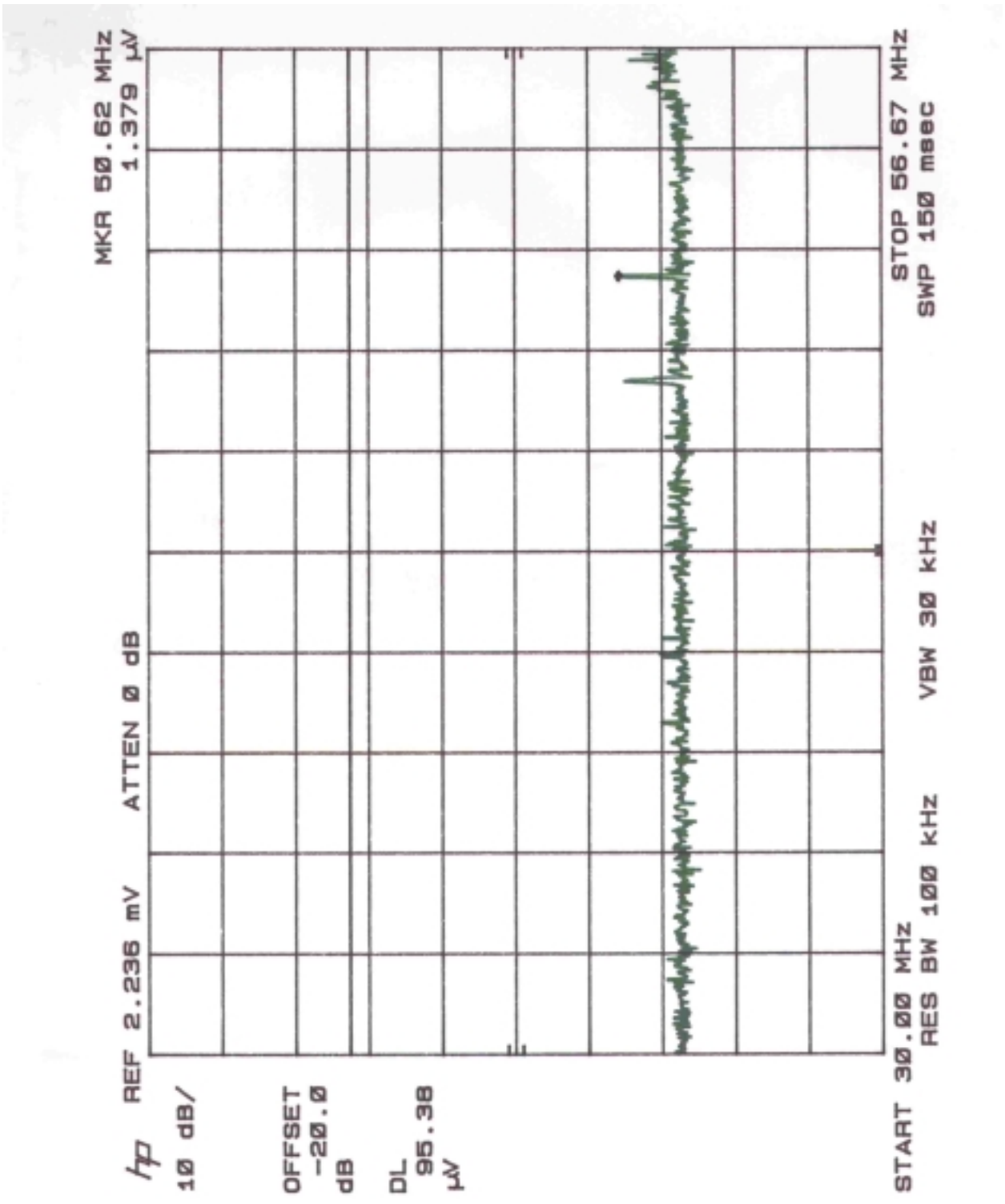
AH Systems, Inc. Motorized Turntable

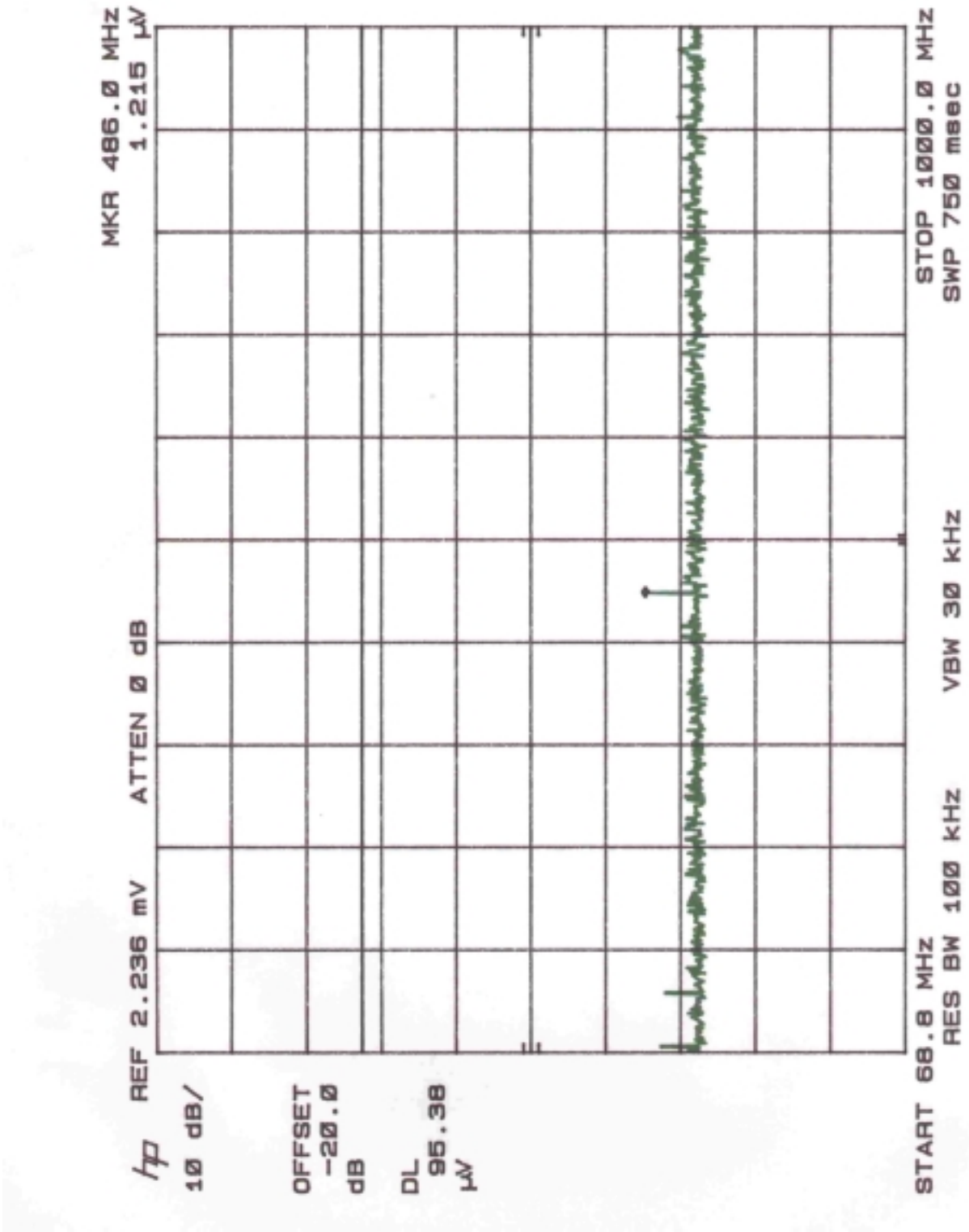
RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

APPENDIX A

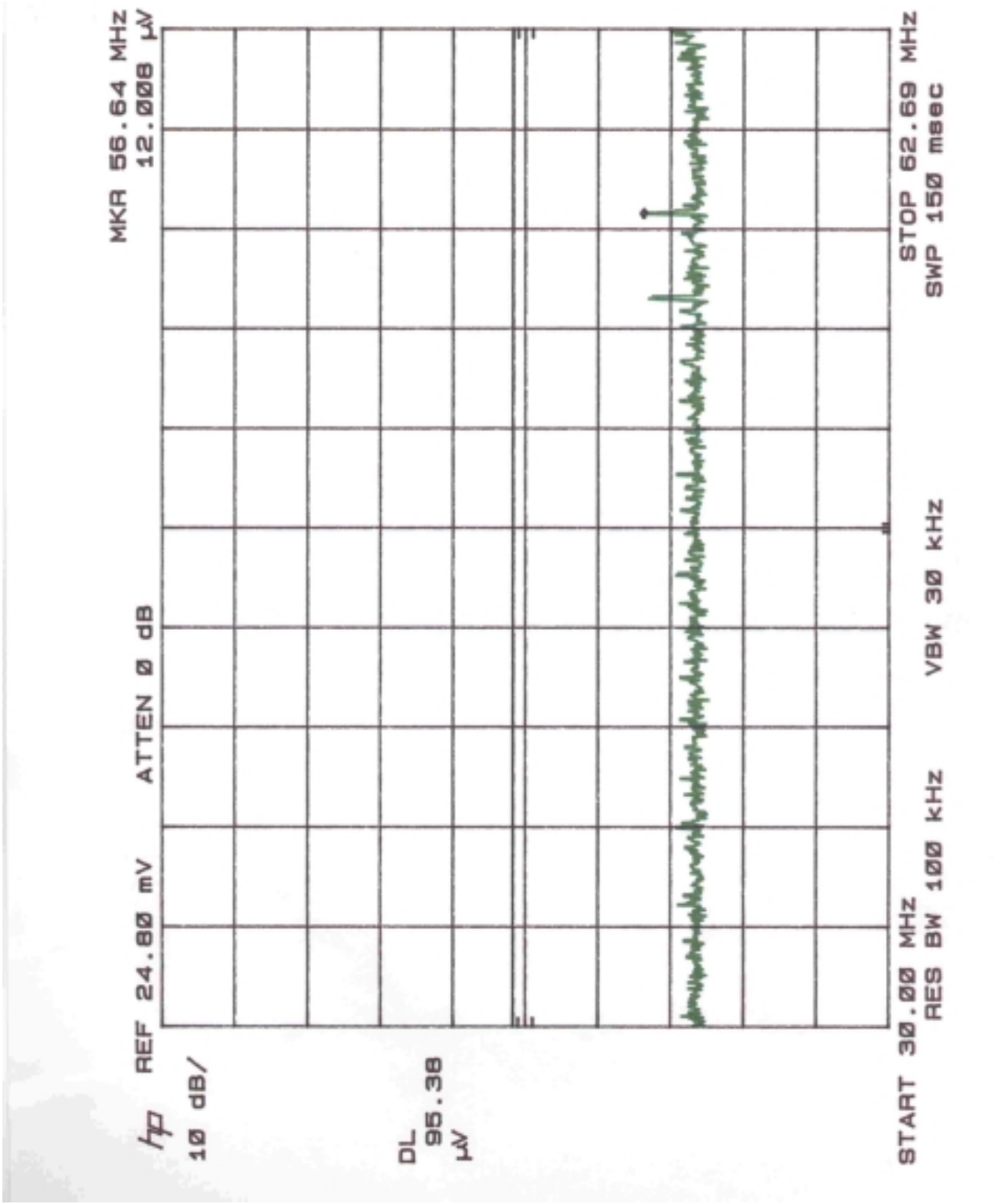
SPURIOUS EMISSIONS PLOTS FOR CHANNEL 3

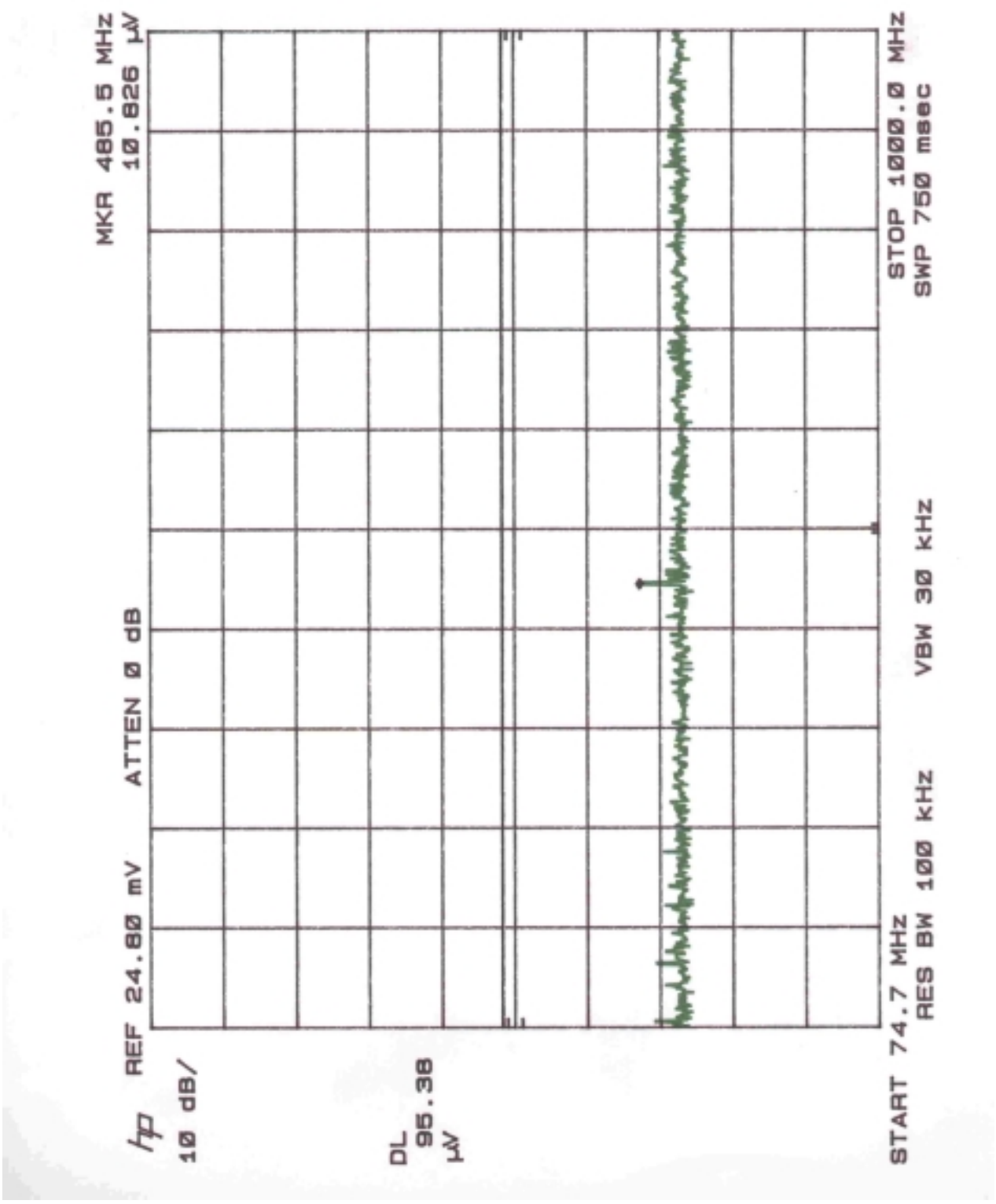

MKR 50.62 MHz
1.379 µV
REF 2.236 mV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
DL
95.38
µV
START 30.00 MHz
RES BW 100 kHz
VBW 30 kHz
STOP 56.67 MHz
SWP 150 msec


MKR 486.0 MHz
1.215 µV
REF 2.236 mV
ATTEN 0 dB
10 dB/
OFFSET
-20.0
dB
DL
95.38
µV
START 68.8 MHz
RES BW 100 kHz
VBW 30 kHz
STOP 1000.0 MHz
SWP 750 msec

APPENDIX B

SPURIOUS EMISSIONS PLOTS FOR CHANNEL 4


MKR 56.64 MHz
12.008 µV
REF 24.80 mV
ATTEN 0 dB
10 dB/
DL
95.38
µV
START 30.00 MHz
RES BW 100 kHz
VBW 30 kHz
STOP 62.69 MHz
SWP 150 msec


MKR 485.5 MHz
10.826 µV
REF 24.80 mV
ATTEN 0 dB
10 dB/
DL
95.38
µV
START 74.7 MHz
RES BW 100 kHz
VBW 30 kHz
STOP 1000.0 MHz
SWP 750 msec