TEST MEASUREMENTS REPORT

ACCORDING TO FCC Part 2 and Part 95

FOR

HEAD CONNECTION SYSTEMS Ltd.

EQUIPMENT UNDER TEST:

FRS Transceiver, model PAWN 101-460

FCC ID:M5U-101-460

Prepared by: ____ __
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ACCREDITED
839.01

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Description of equipment under test

Test item	FRS transceiver, FCC ID:M5U-101-460
Manufacturer	Head Connection Systems Ltd.
Types (Models)	PAWN 101-460
Receipt date	September 2, 1998

Applicant information

Applicant's representative & responsible person	Mr. Yoram Peled, marketing manager
Company	Head Connection Systems Ltd.
Address	11 Moshav Ben-Shemen
P.O. Box	NA
Postal code	73115
City	Moshav Ben-Shemen
Country	Israel
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Test performance

Project Number:	13038
Location	Hermon Laboratories
Test started	September 2, 1998
Test completed	November 8, 1998
Purpose of test	Type acceptance (certification)
Test specification(s)	FCC Part 2, §§ 2.987, 2.989, 2.993, 2.995, 2.997, FCC Part 95, §§ 95.627, 95.631, 95.633, 95.635, 95.637, 95.639

Through this report a point is used as the decimal separator and the thousands are counted with a comma.
This report is in conformity with EN 45001 and ISO GUIDE 25.
The test results relate only to the items tested.

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1 General Information

1.1 Abbreviations and Acronyms

The following abbreviations and acronyms are applicable to this test report:

AVR	average
BW	bandwidth
cm	centimeter
dB	decibel
dB(µV)	decibel referred to one microvolt
dB(µV/m)	decibel referred to one microvolt per meter
EMC	electromagnetic compatibility
EUT	equipment under test
FM	frequency modulation
FRS	Family Radio Service
GHz	gigahertz
HL	Hermon Laboratories
Hz	hertz
IF	intermediate frequency
kHz	kilohertz
m	meter
MHz	megahertz
msec	millisecond
NA	not applicable
NARTE	National Association of Radio and Telecommunications Engineers, Inc.
Ω	ohm
ppm	part per million
RBW	resolution bandwidth
RE	radiated emission
RF	radio frequency
QP	quasi-peak (detector)
VBW	video bandwidth
V	volt
V/m	volt per meter
UHF	ultra high frequency

1.2 Specification References

CFR 47 part 2, 10/1997	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
CFR 47 part 95, 10/1997	Personal Radio Services
ANSI C63.2:06/1987	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4:1992	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

1.3 EUT Description

The EUT, PAWN 101-460 (or PAWN 101-400), is a Family Radio Service two way voice communication system (transceiver) for extreme acoustic noise environment. The EUT is built into a highly efficient hearing protection device and operates at 14 channel frequencies from 462.5625 to 467.7125 MHz, transmits F3E type emission. The incorporated receiver is superheterodyne type.
Maximum rated RF output power is 0.5 W (ERP). The antenna is an integral part of the transceiver, vertically polarized and has no gain (as compared to a half-wave dipole). The EUT is supplied by 4.5 V rechargeable battery.

1.4 Statement of Manufacturer

I, Yoram Peled, marketing manager of Head Connection Systems Ltd., declare that the transceiver, model PAWN 101-460, was tested from September 2 to November 8, 1998 by Hermon Laboratories and which this test report applies to, is identical of the equipment that will be marketed.

The term identical means identical within the variations that can be expected to arise as a result of quantity production technique.

Mr. Yoram Peled, marketing manager
Head Connection Systems Ltd.

Signature:_ ___

Date:__April 26, 1999_____

2 Test Facility Description

2.1 General

Tests were performed at Hermon Laboratories, which is a fully independent, private EMC, Safety and Telecommunication testing facility. Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), listed by Industry Canada for radiated measurements (file numbers IC 2186-1 for OATS and IC 2186-2 for anechoic chamber), recognized by VDE (Germany) for witness test, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-809 for anechoic chamber, C-845 for conducted emissions site), assessed by NMi Certin B.V. (Netherlands) for a number of EMC, Telecommunications and Safety standards, recognized by TUV Sudwest (Germany) for Safety testing, and Accredited by AMTAC (UK) for safety of Medical Devices. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO GUIDE 25/EN 45001 for EMC, Telecommunications and Product Safety Information Technology Equipment (Certificate No. 839.01).

Address: PO Box 23, Binyamina 30550, Israel.

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Fax: +972 (0)6628 8277

Person for contact: Mr. Alex Usoskin, testing and QA manager.

2.2 Equipment calibration

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error. The standards and instruments used in the calibration system conform to the present requirements of MIL-STD-45662A.
The laboratory standards are calibrated by the third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

2.2.1 Uncertainty in Hermon Labs Measurements

Conducted Emissions (95% Confidence)	9 kHz to 150 kHz : ± 1.09 dB Combined standard uncertainty ± 2.18 dB Expanded uncertainty 150 kHz to 30 MHz : ± 1.21 dB Combined standard uncertainty ±2.42 dB Expanded uncertainty
Radiated Emissions (95% Confidence)	Biconical Antenna: 3 m measuring distance : + 2.032 dB Combined standard uncertainty + 4.06 dB Expanded uncertainty - 1.99 dB Combined standard uncertainty - 3.98 dB Expanded uncertainty 10 m measuring distance : + 1.99 dB Combined standard uncertainty + 3.98 dB Expanded uncertainty - 2.04 dB Combined standard uncertainty - 4.08 dB Expanded uncertainty Log periodic Antenna: 3 m measuring distance : + 2.37 dB Combined standard uncertainty + 4.74 dB Expanded uncertainty - 1.63 dB Combined standard uncertainty - 3.26 dB Expanded uncertainty 10 m measuring distance : + 1.53 dB Combined standard uncertainty + 3.06 dB Expanded uncertainty - 1.50 dB Combined standard uncertainty- -3.00 dB Expanded uncertainty

2.3 Laboratory Personnel

The three people of Hermon Laboratories that have participated in measurements and documentation preparation are: Dr. Edward Usoskin - C.E.O., Mrs. Eleonora Pitt - test engineer and Mrs. Marina Cherniavsky - certification engineer.
Dr. E. Usoskin is an EMC specialist, M. Cherniavsky is a telecommunication engineer certified by the National Association of Radio and Telecommunications Engineers (NARTE, USA.).
The Hermon Laboratories' personnel that participated in this project have more than 90 years combined experience time in EMC measurements and electronic products design.

2.4 Statement of Qualification

The test measurement data supplied in this test measurement report having been received by me, is hereby duly certified. The following is a statement of my qualifications:
I am an engineer, graduated from university in 1974 with an MScEE degree, have obtained 26 years experience in EMC measurements and have been with Hermon Laboratories since 1991.

Name: Mrs. Eleonora Pitt Signature:__ _____
Position: test engineer Date: March 30, 1999

I hereby certify that this test measurement report was prepared by me and is hereby duly certified. The following is a statement of my qualifications.
I am an engineer, graduated from university in 1971, with an MScEE degree, have obtained 26 years experience in electronic products design and development. Also, I am a Telecommunication Class II engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA.), the certificate no. is E2-03410 and have been with Hermon Labs since 1991.

Name: Mrs. Marina Cherniavsky Signature: _ ___
Position: certification engineer Date: March 30, 1999

I hereby certify that this test measurement report was prepared under my direction and that to the best of my knowledge and belief, the facts set in the report and accompanying technical data are true and correct.
The following is a statement of my qualifications.
I have a Ph.D. degree in electronics, have obtained more than 42 years of experience in EMC, Safety, Telecommunications measurements and electronic product design.
Also, I am an EMC engineer certified by the National Association of Radio and Telecommunications Engineers, Inc. (USA). The certificate no. is EMC-000623-NE, Senior Member, and have been with Hermon Labs since 1986.

Name: Dr. Edward Usoskin Signature: _ ___
Position: C.E.O. Date: March 30, 1999

3 Test Measurements

3.1 Channel frequencies usage test according to CFR 47 Part 95, § 95.627 (a)

3.1.1 Definition of the test

This test was performed to prove that the EUT uses 14 channel frequencies given below.

Channel No.	Frequency, MHz
1	462.5625
2	462.5875
3	462.6125
4	462.6375
5	462.6625
6	462.6875
7	462.7125
8	467.5625
9	467. 5875
10	467. 6125
11	467. 6375
12	467. 6625
13	467. 6875
14	467. 7125

3.1.2 Test set-up

The EUT test setup is shown in Photograph 3.1.1.

3.1.3 Test results

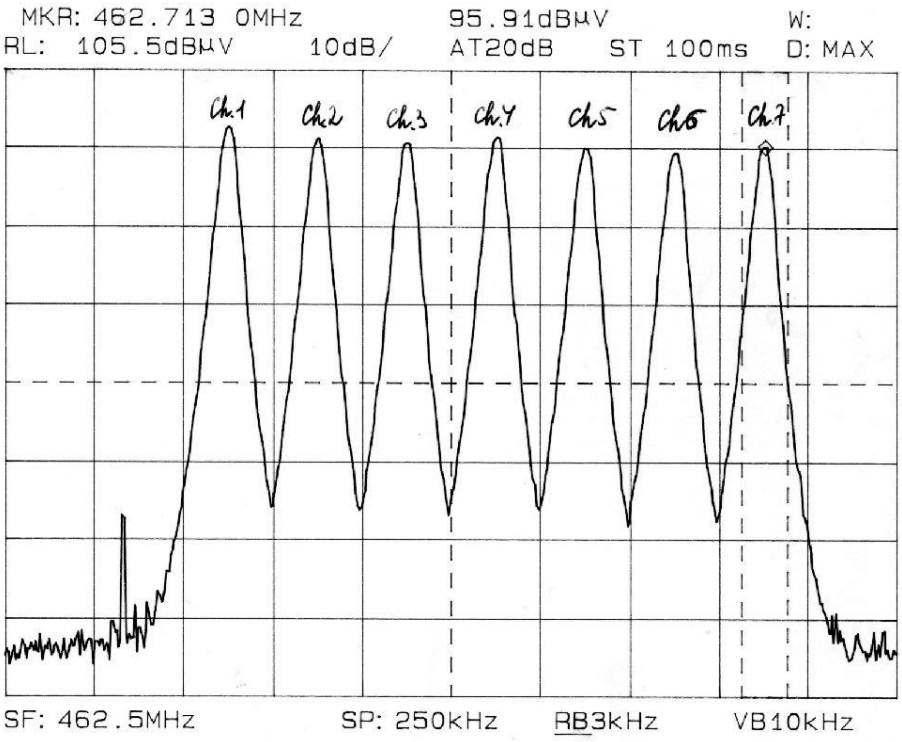
Two Plots 3.1.1 and 3.1.2 show 14 channels used by the EUT. The EUT successfully passed this test.

Reference numbers of test equipment used

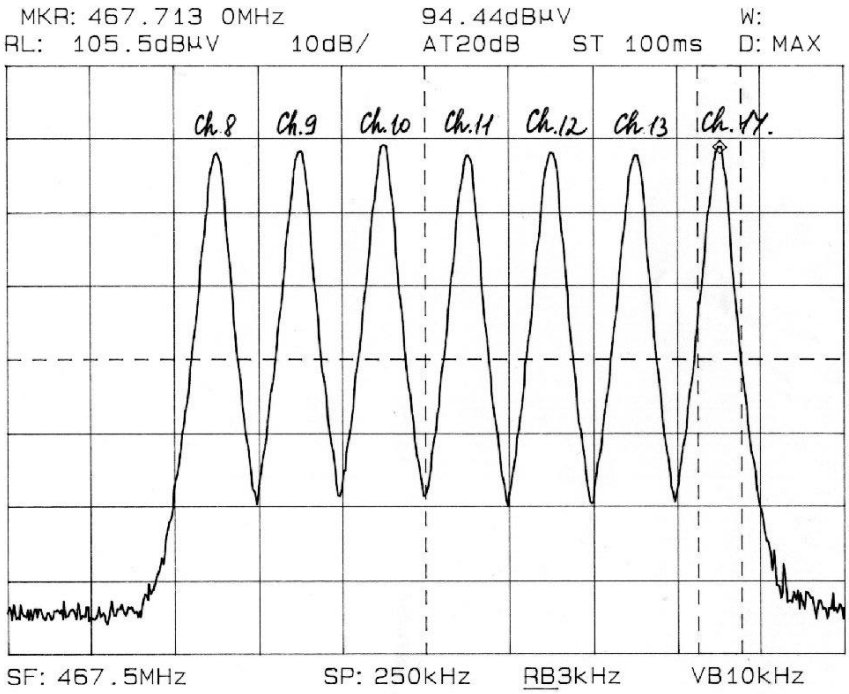
HL 0129	HL 0279	HL 0693	HL 0792

Full description is given in Appendix A.

Plot 3.1.1
Channel frequencies test results



Plot 3.1.2
Channel frequencies test results



Photograph 3.1.1
Channel frequencies test setup

3.2 Frequency stability test according to Part 95, §95.627(b), Part 2, §2.995 and ANSI C63.4:1992

3.2.1 Definition of the test

This test was performed to measure the frequency stability versus ambient temperatures from -20°C to +50°C (the temperature range specified in ANSI C63.4:1992). The maximum allowed frequency tolerance is 0.00025%.

3.2.2 Test set-up

The test setup is the same as in Test 3.1.

3.2.3 Test results

The test was performed at 3 unmodulated channel frequencies (low, middle, high). The test results are given in the Table 3.2.1.

Table 3.2.1
Frequency stability test results

Channel frequency, MHz	Freq. stability limit, ±kHz	Measured frequency tolerance, ±kHz vs temperature, ºC								Pass/ Fail
		-20	-10	0	10	20	30	40	50	
462.5625 (channel 1)	1.156	-1	-0.2	0.7	0.8	0.34	-0.3	-0.1	0.94	Pass
462.7125 (channel 7)	1.157	-0.9	-0.1	0.8	0.8	-0.1	0	-0.18	0.47	Pass
467.7125 (channel 14)	1.167	-0.8	-0.1	0.91	0.9	0.4	0.11	-0.2	0.51	Pass

Reference numbers of test equipment used

HL 0129	HL 0279	HL 0500	HL 0693	HL 0792		

Full description is given in Appendix A.

3.3 Emission bandwidth test according to Part 95, §95.633(c) and Part 2, § 2.989

3.3.1 Definition of the test

This test was performed to determine that the Tx authorized bandwidth includes 99.5% of radiated power and is not more than 12.5 kHz. The 99.5 % level is 23 dB below the carrier.

3.3.2 Test set-up

The EUT was configured as shown in Photograph 3.3.1.

3.3.3 Test results

The EUT was tested at 3 channel frequencies (low, middle, high) and has passed the test requirements. The test results are given in Table 3.3.1 and Plots 3.3.1 to 3.3.3.

Table 3.3.1
Emission bandwidth test results

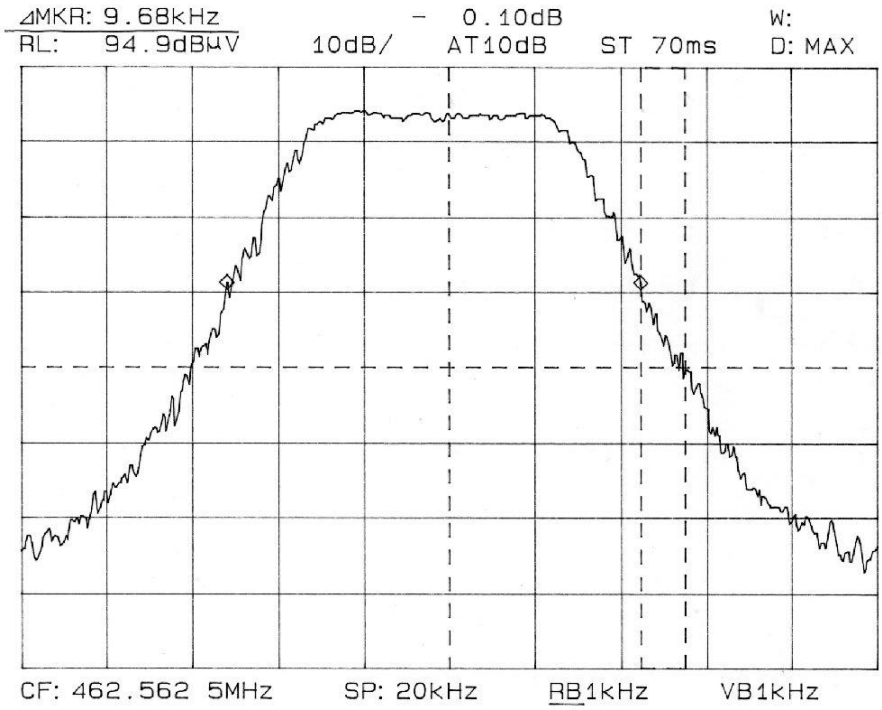
Channel frequency, MHz	Measured result, kHz	Pass/Fail
462.5625 (channel 1)	9.68	Pass
462.7125 (channel 7)	11.68	Pass
467.7125 (channel 14)	9.16	Pass

Reference numbers of test equipment used

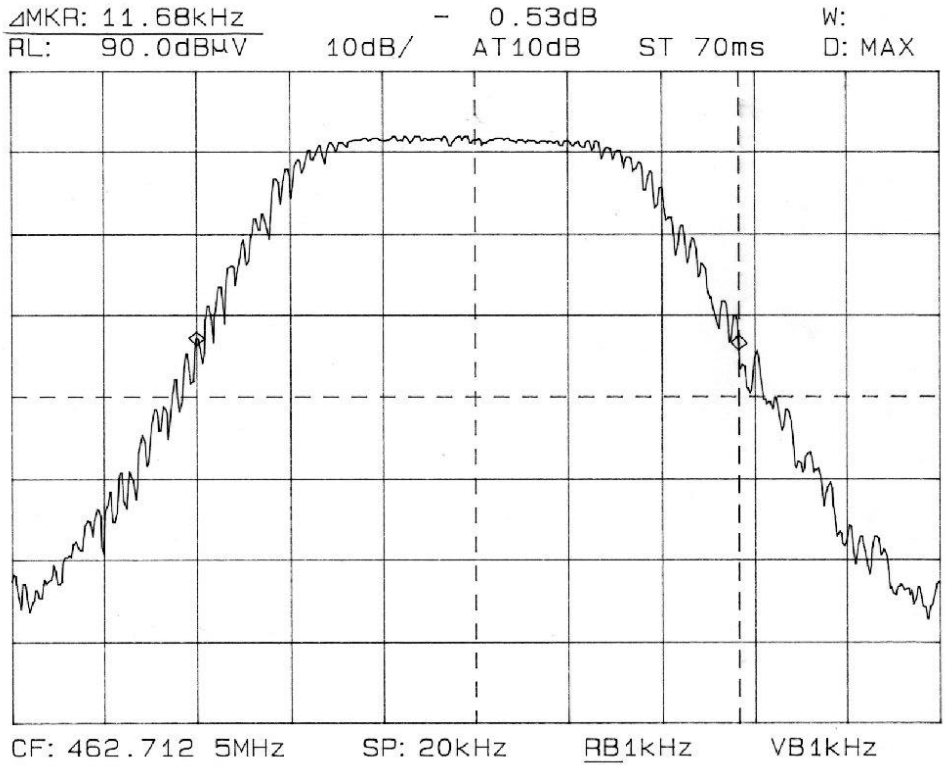
HL 0129	HL 0279	HL 0693	HL 0792			

Full description is given in Appendix A.

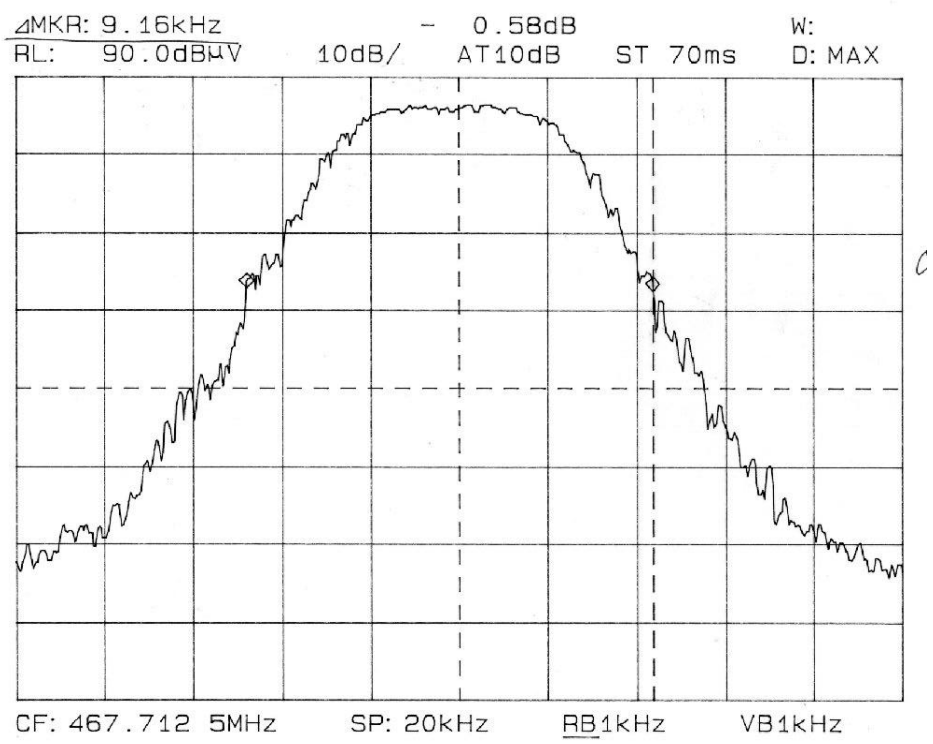
Plot 3.3.1
Emission bandwidth test results



Plot 3.3.2
Emission bandwidth test results



Plot 3.3.3
Emission bandwidth test results



Photograph 3.3.1
Emission bandwidth test setup

3.4 Maximum transmitted power test according to Part 95, §95.639(d)

3.4.1 Definition of the test

This test was performed to demonstrate that the EUT maximum effective radiated power (ERP) is not more than 0.5 W (27 dBm).

3.4.2 Test set-up

The EUT was tested according to the substitution method with dipole antenna. The radiated emissions measurements were performed with the log periodic antenna, installed on the variable height antenna mast in the Hermon Laboratories open field test site at 3 meters measuring distance.

The EUT was installed on the 0.8 m high wooden table which was on the top of the metal turntable flush mounted with the ground plane. To find the maximum radiation measuring antenna height was changed from 1 to 4 m, the turntable was rotated 360° and the antennas polarization was changed from vertical to horizontal.

3.4.3 Test results

The field strength generated by the EUT was measured at 3 unmodulated carrier frequencies: 462.5625 MHz, 462.7125 MHz and 467.7125 MHz.
The center of substituting transmitting antenna coincided with the reference point of the EUT it has replaced (point where an external antenna is connected to the cabinet). The input signal to the transmitting antenna ($P_{out\ gen}$) was adjusted in level until an equal related level detected from the transmitter by the measuring receiver was obtained.
Maximum ERP was calculated from equation:

$$ERP_{max} = P_{out\ gen} - \text{Cable loss} + \text{Antenna gain} =$$
$$=20\ \text{dBm} – 1.9\ \text{dB} + 0.95\ \text{dB} = 19.1\ \text{dBm} = 0.081\ \text{W}$$

The test results are shown in Table 3.4.1.

Reference numbers of test equipment used

HL 0027	HL 0034	HL 0038	HL 0275	HL 0287	HL 0557	HL 0614
HL 0661						

Full description is given in Appendix A**.**

Table 3.4.1 Effective radiated power measurement test results

TEST SPECIFICATION: FCC part 95, §95.639(d)
COMPANY: Head Connection Systems Ltd.
EUT: PAWN 101-460
DATE: September 17, 1998
RELATIVE HUMIDITY: 57%
AMBIENT TEMPERATURE: 24°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Freq. MHz	Radiated Emission measured result dB (μV/m)	Antenna Gain dB	Cable Loss dB	Generator P out dBm	ERP dBm	ERP W	Spec. Limit dBm	Spec. Margin dB	Pass/ Fail
462.5625	89	0.95	1.9	20	19.1	0.081	27	7.9	Pass
462.7125	89	0.95	1.9	20	19.1	0.081	27	7.9	Pass
467.7125	89	0.95	1.9	20	19.1	0.081	27	7.9	Pass

Test parameters:
The listed test results were obtained at the following conditions:
Detector type = peak
Resolution bandwidth = 120 kHz
Antenna type – log periodic.
Antenna polarization - horizontal

Table calculations and abbreviations:
ERP (dBm) = P_{out} (dBm) – Cable Loss (dB) + Antenna Gain (dB)
Spec. margin = specification margins = dB below (negative if above) specification limit.

Test performed by:
Mrs. Eleonora Pitt, test engineer

Hermon Labs

3.5 Unwanted radiation test according to Part 95, §95.635 and Part 2, §2.991

3.5.1 Definition of the test

This test was performed to determine that the power of each unwanted emission should be attenuated below the transmitted power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by more than 50% up and including 100% of the authorized bandwidth (6.25 kHz – 12.5 kHz) at least 25 dB;

(2) On any frequency removed from the center of the authorized bandwidth by more than 100% up and including 250% of the authorized bandwidth (12.5 kHz – 31.25 kHz) at least 35 dB;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250% (31.25 kHz) according to the equation [43 + 10log (carrier power P in watts)] dB = =33 dB at maximum ERP=0.1 W.

3.5.2 Test set-up

The EUT was configured as shown in Photograph 3.5.1.

3.5.3 Test results

To detect unwanted emissions the test was performed with the transmitter operating at 3 carrier channel frequencies: 462.5625 MHz, 462.7125 MHz and 467.7125 MHz. The frequency range from 9 kHz up to 5 GHz was investigated. The spectrum analyzer bandwidth settings are shown in plots.
The test results are given in Table 3.5.1 and in Plots 3.5.1 to 3.5.33.
The EUT has passed the test requirements.
The marker frequencies 469 MHz and 463 MHz in Plots 3.5.7 and 3.5.11 correspond to 462.5625 MHz carrier frequency, the marker frequency 464.1 MHz in Plot 3.5.20 corresponds to 462.7125 MHz carrier frequency, the marker frequency 469.7 MHz in Plot 3.5.28 corresponds to 467.7125 MHz carrier frequency (due to large spectrum analyzer span the marker readings are inaccurate).

Reference numbers of test equipment used

HL 0129	HL 0279	HL 0693	HL 0792			

Full description is given in Appendix A.

Table 3.5.1 Unwanted radiation attenuation test results

TEST SPECIFICATION: FCC part 95, §95.635
COMPANY: Head Connection Systems Ltd.
EUT: PAWN 101-460
DATE: September 28, 1998
RELATIVE HUMIDITY: 52%
AMBIENT TEMPERATURE: 22°C

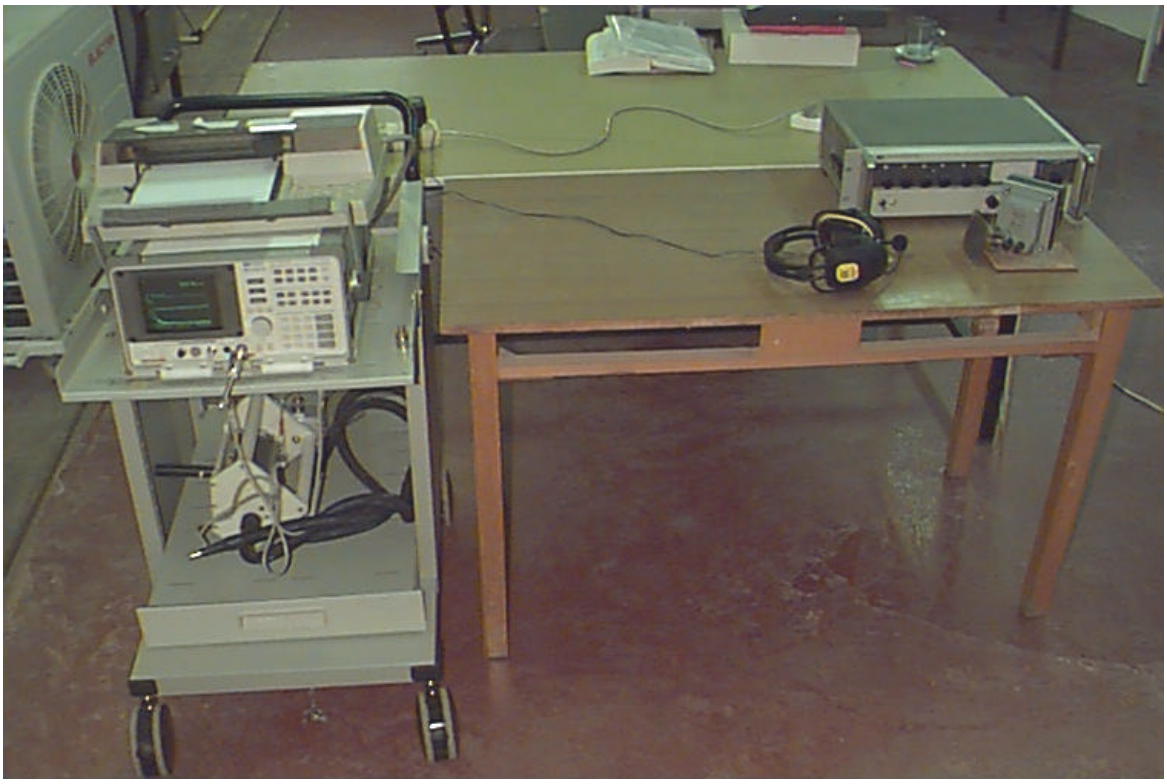
Frequency, MHz	Carrier power, W	Frequency range, removed from the center of authorized bandwidth, kHz	Measured minimum attenuation, dB	Specified Limit, dB	Pass/Fail
462.5625	0.1	6.25 – 12.5	37.41	25	Pass
		12.5 - 31.25	57.97	35	Pass
		More than 31.25	43.23	33	Pass
462.7125	0.1	6.25 – 12.5	39.78	25	Pass
		12.5 - 31.25	62.37	35	Pass
		More than 31.25	43.42	33	Pass
467.7125	0.1	6.25 – 12.5	44.84	25	Pass
		12.5 - 31.25	61.47	35	Pass
		More than 31.25	44.80	33	Pass

Test performed by:
Mrs. Eleonora Pitt, test engineer

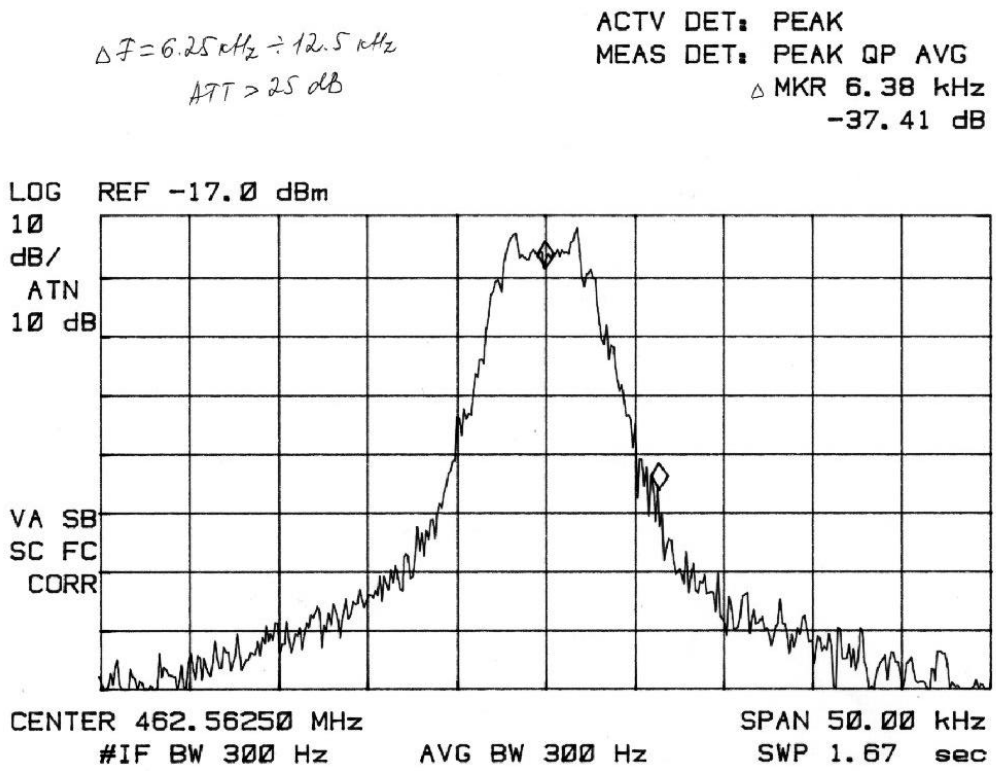
Pitt

Hermon Labs

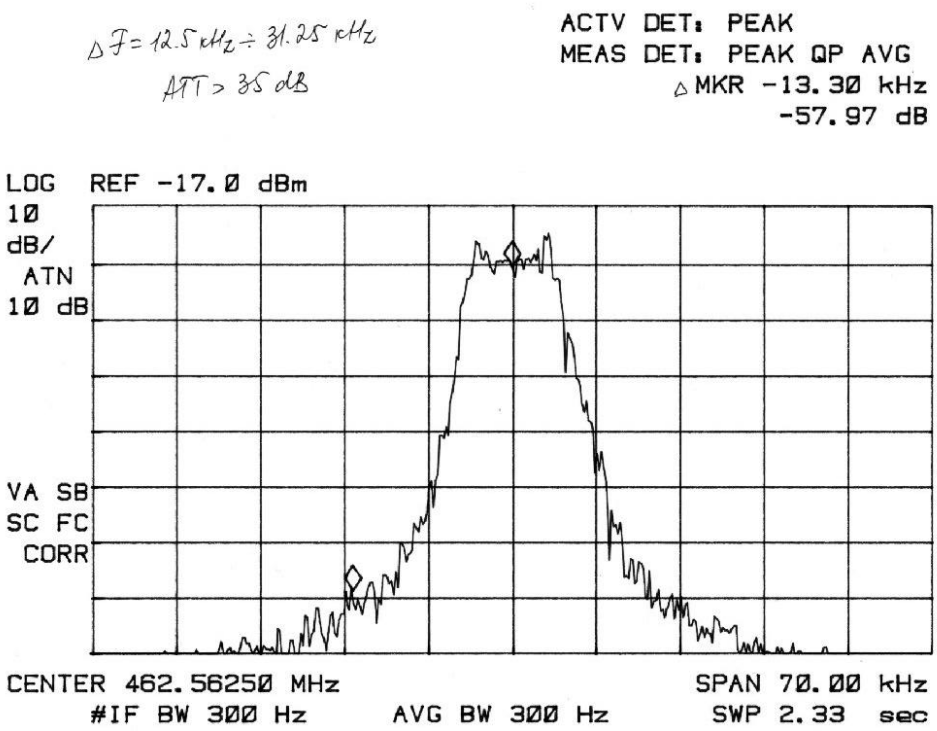
Photograph 3.5.1
Unwanted radiation test setup



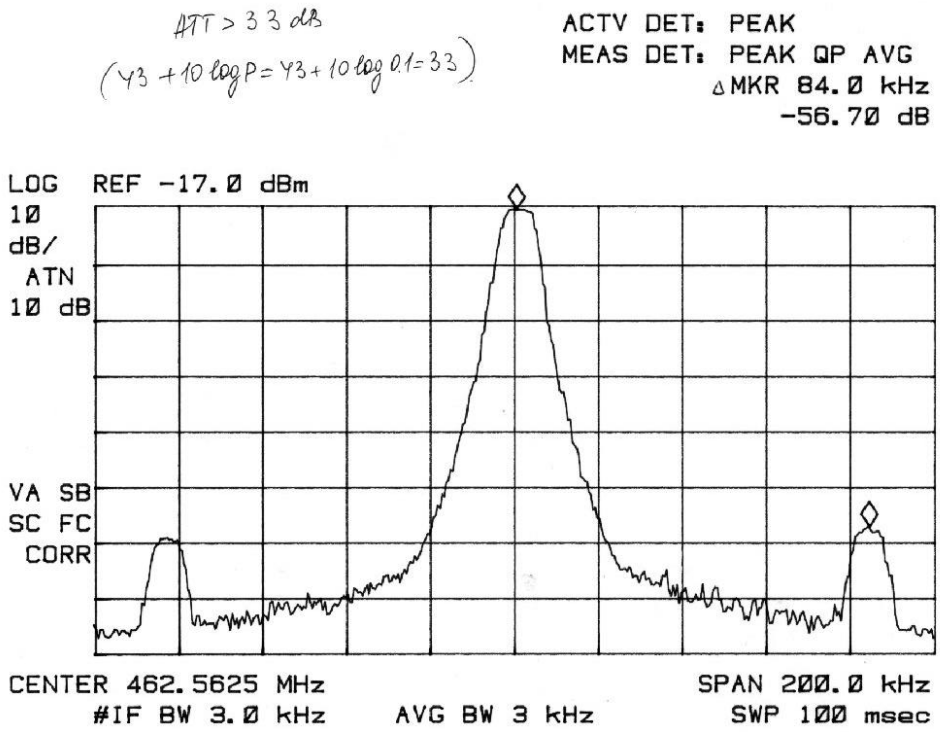
Plot 3.5.1
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



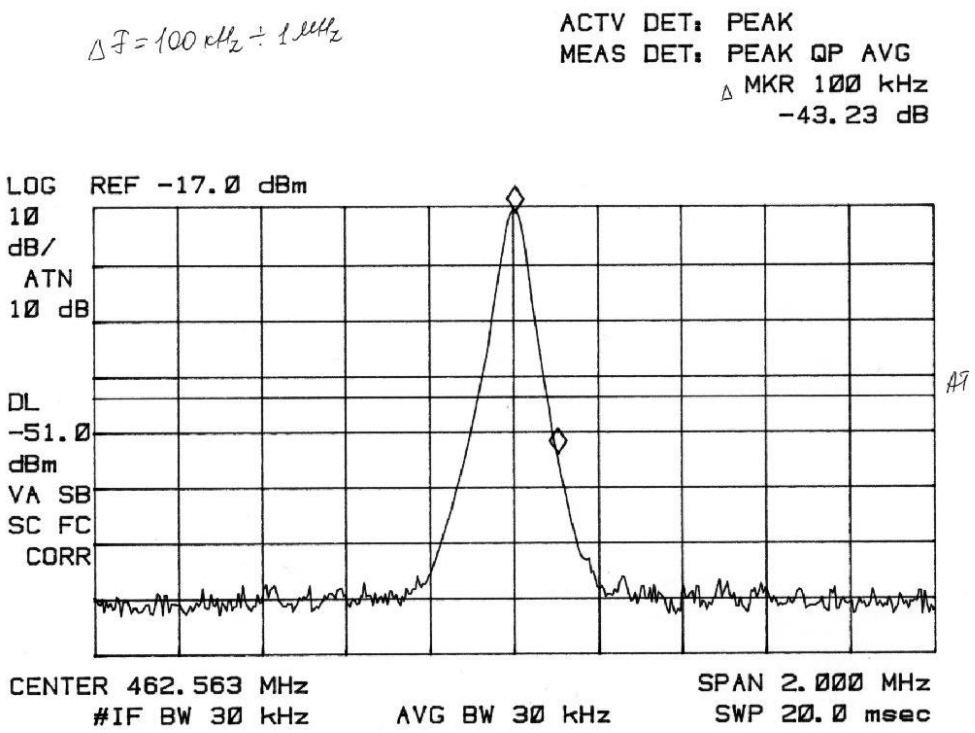
Plot 3.5.2
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



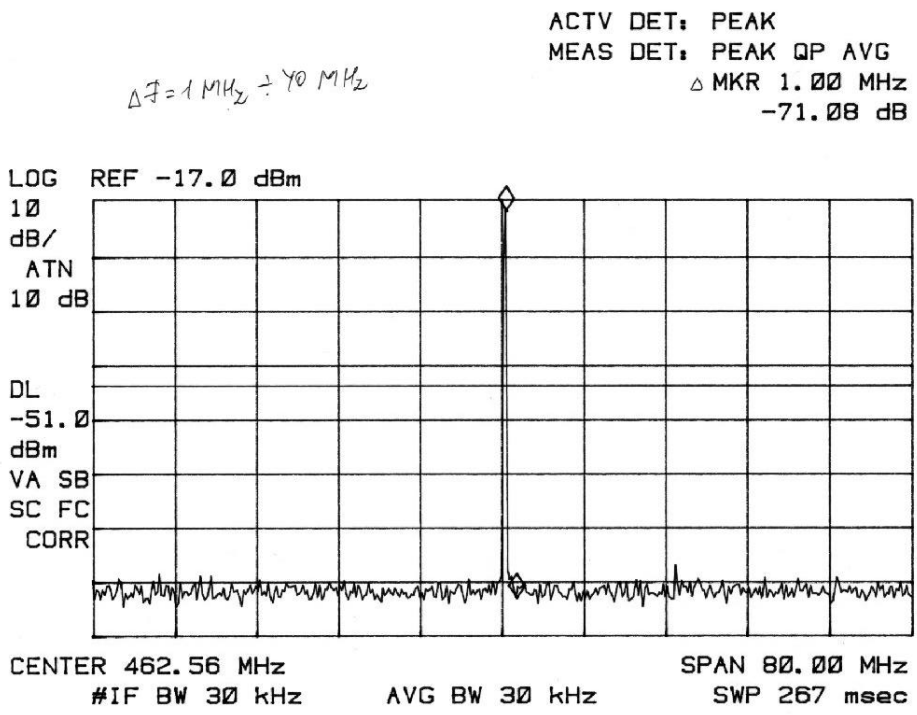
Plot 3.5.3
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



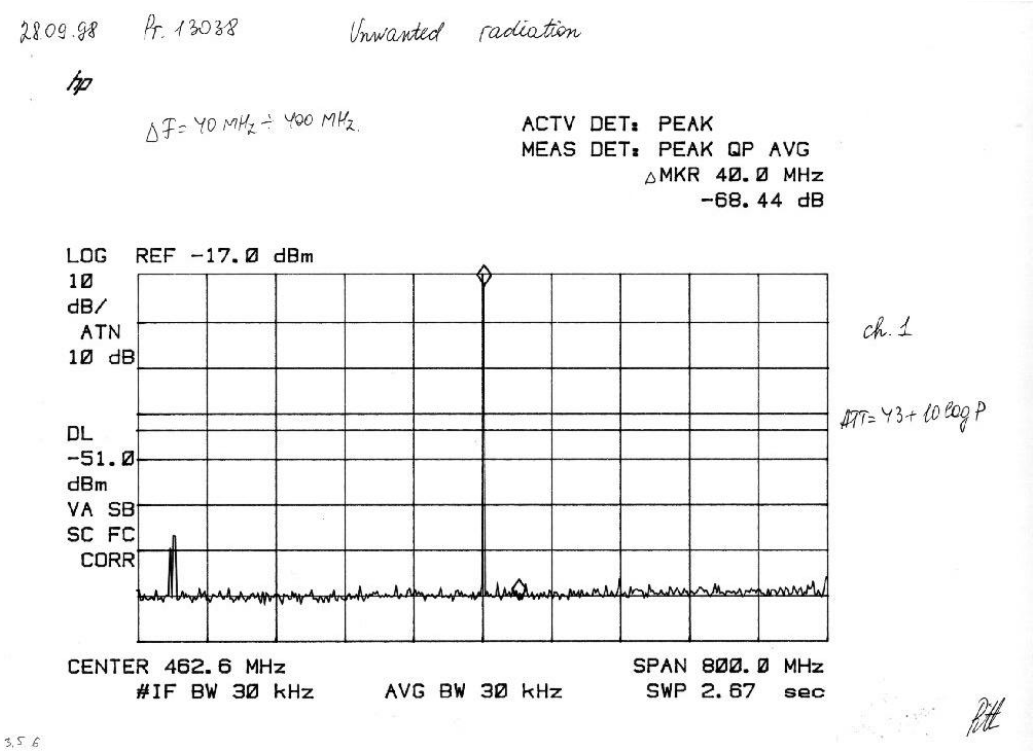
Plot 3.5.4
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



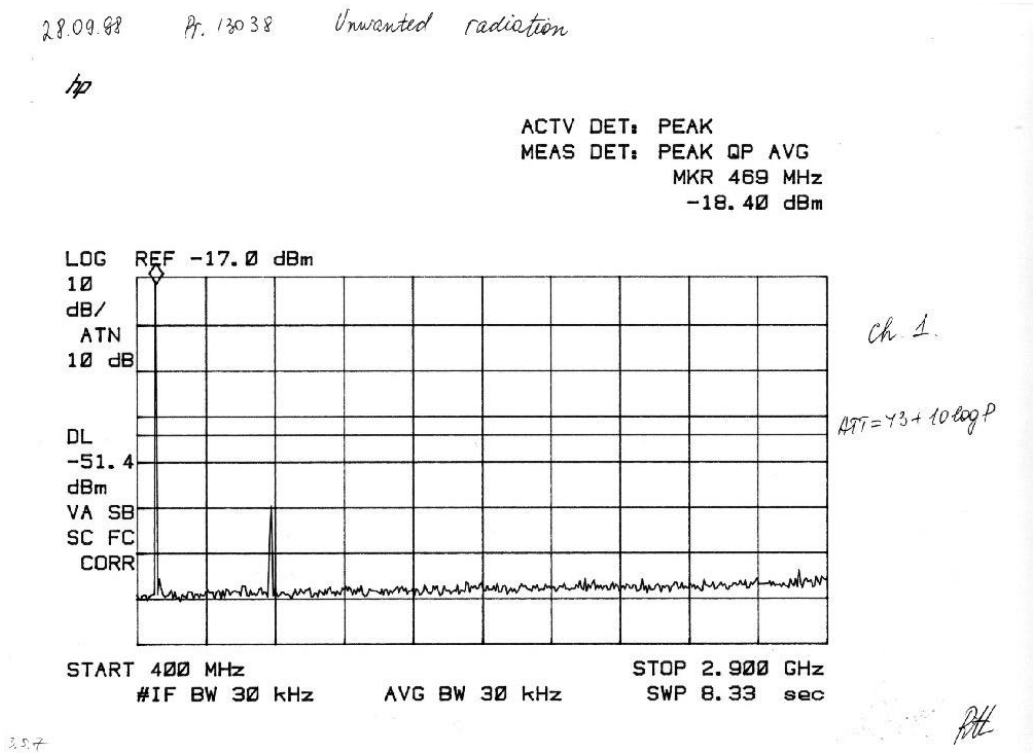
Plot 3.5.5
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



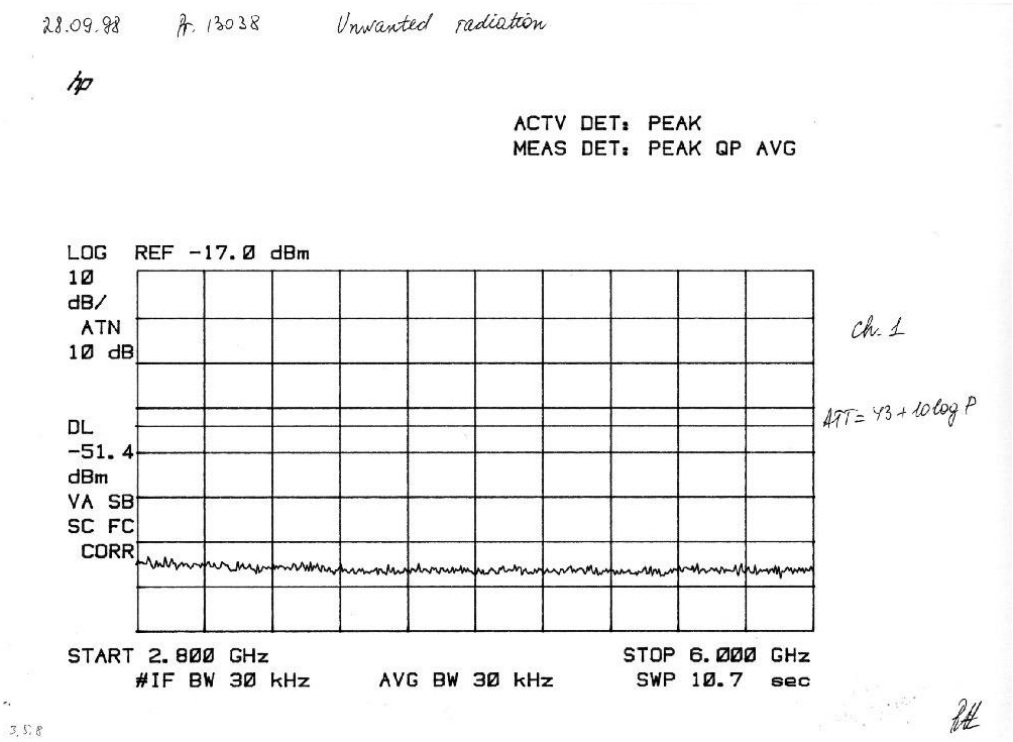
Plot 3.5.6
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



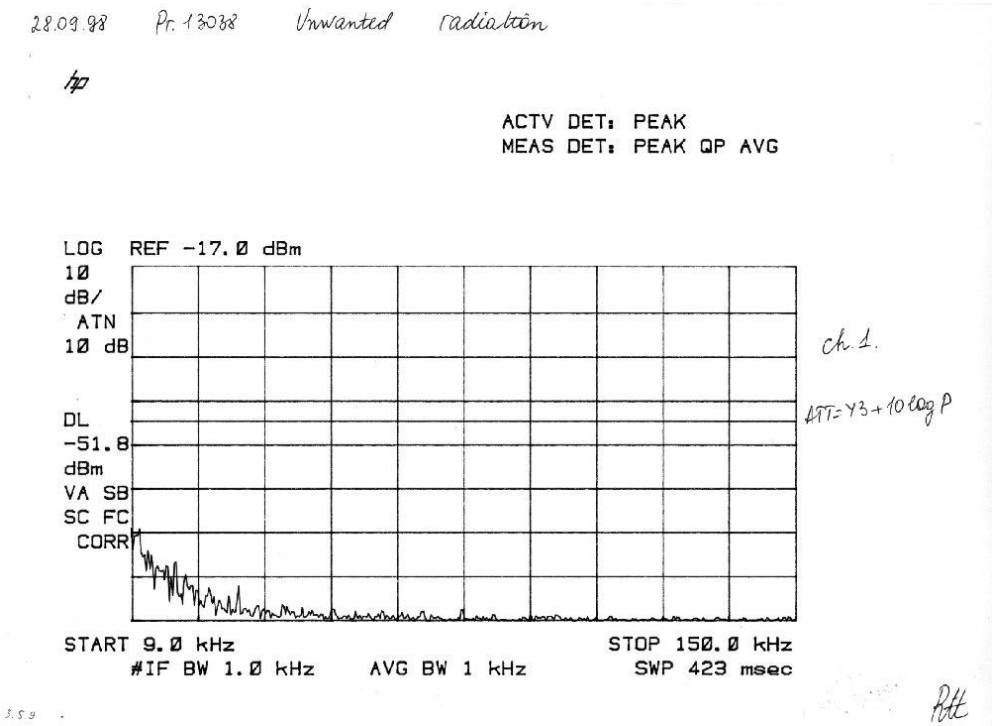
Plot 3.5.7
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



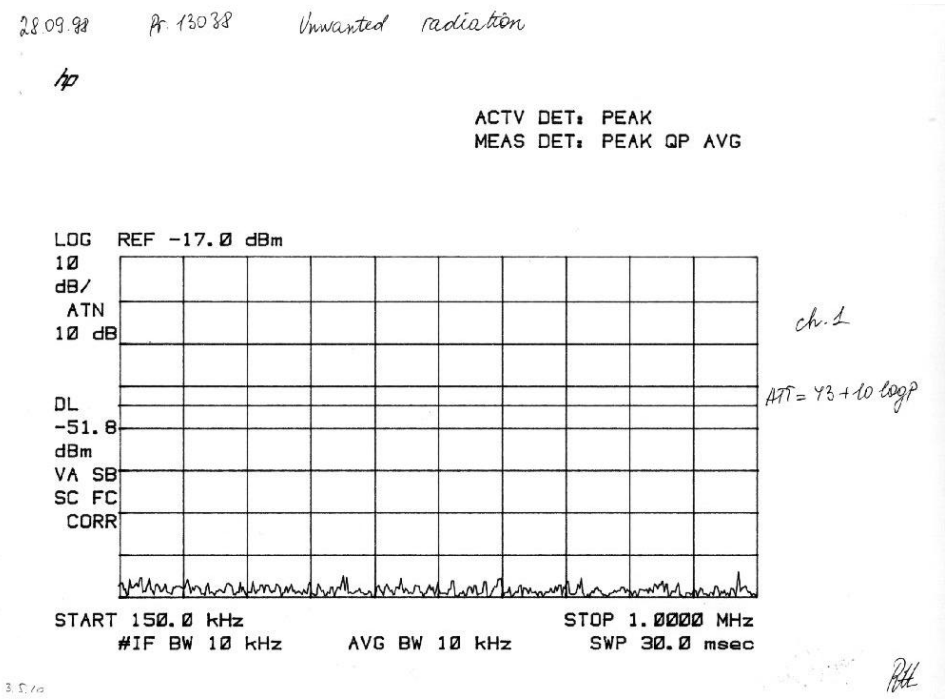
Plot 3.5.8
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



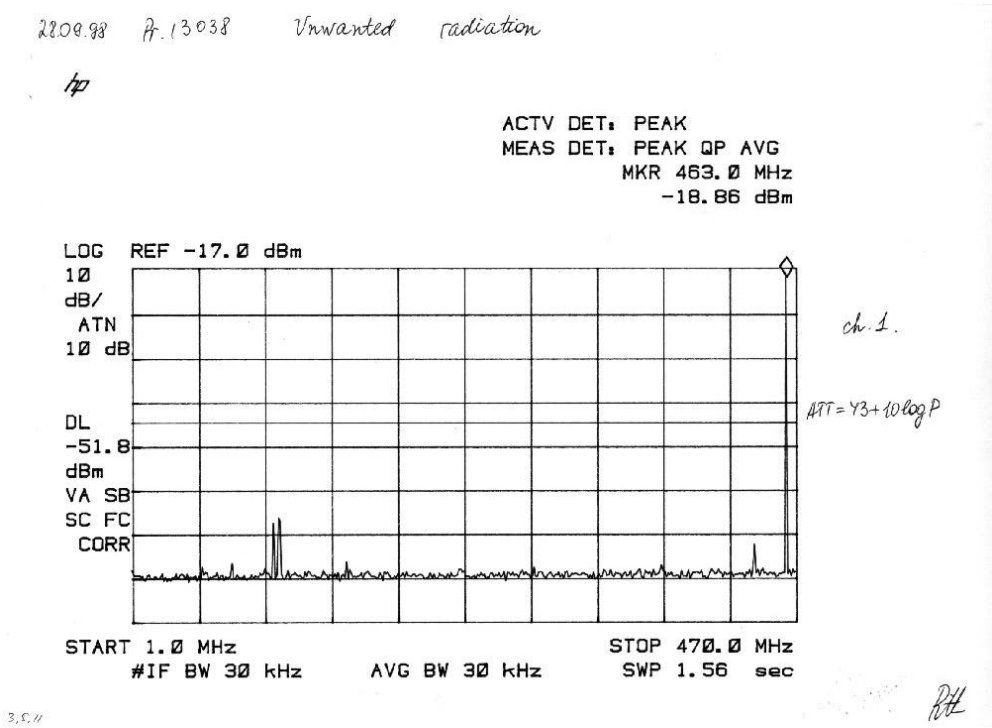
Plot 3.5.9
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



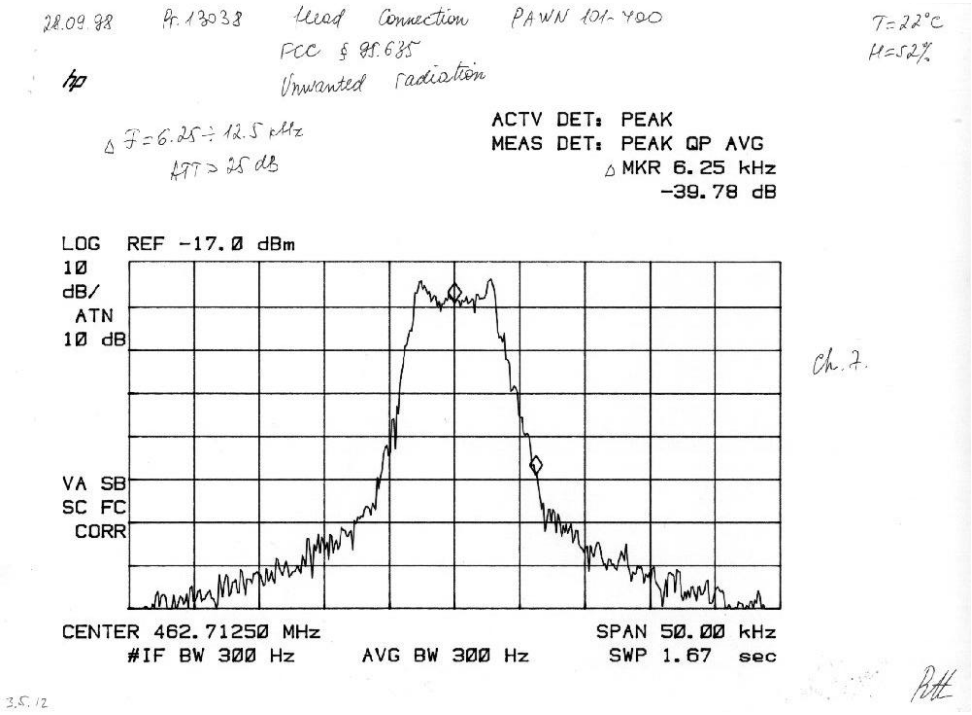
Plot 3.5.10
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



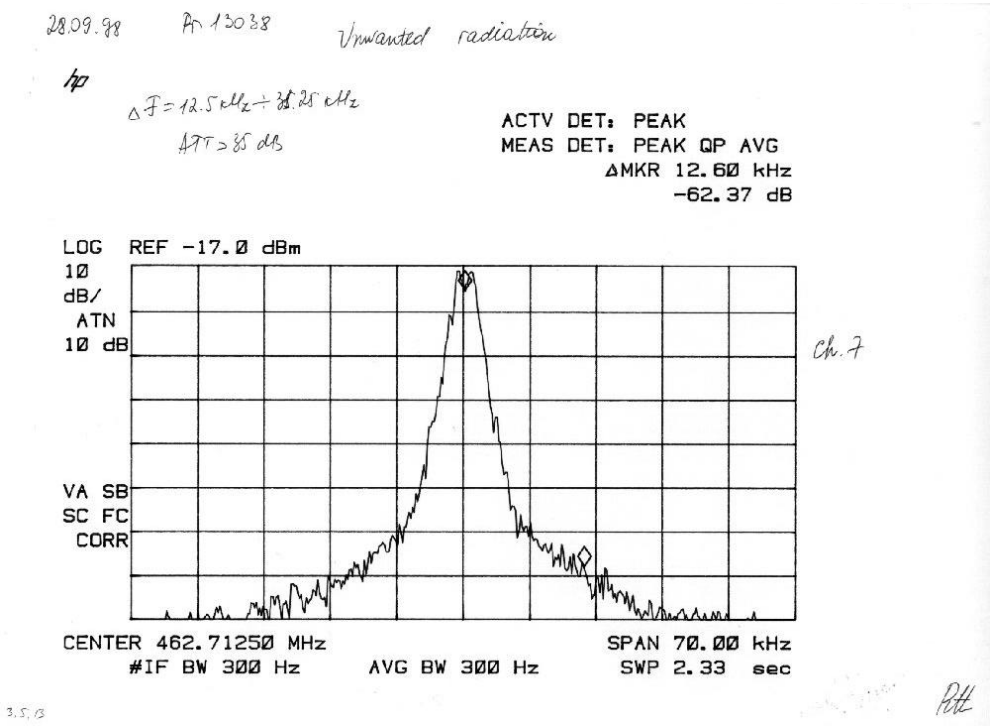
Plot 3.5.11
Unwanted radiation attenuation test results
@ 462.5625 MHz channel frequency



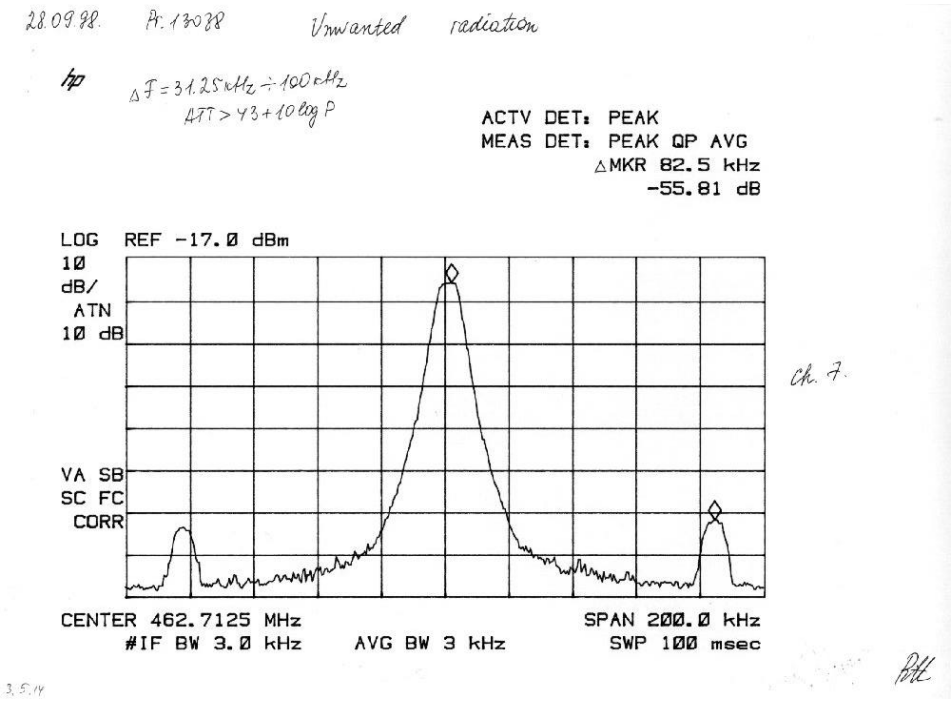
Plot 3.5.12
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



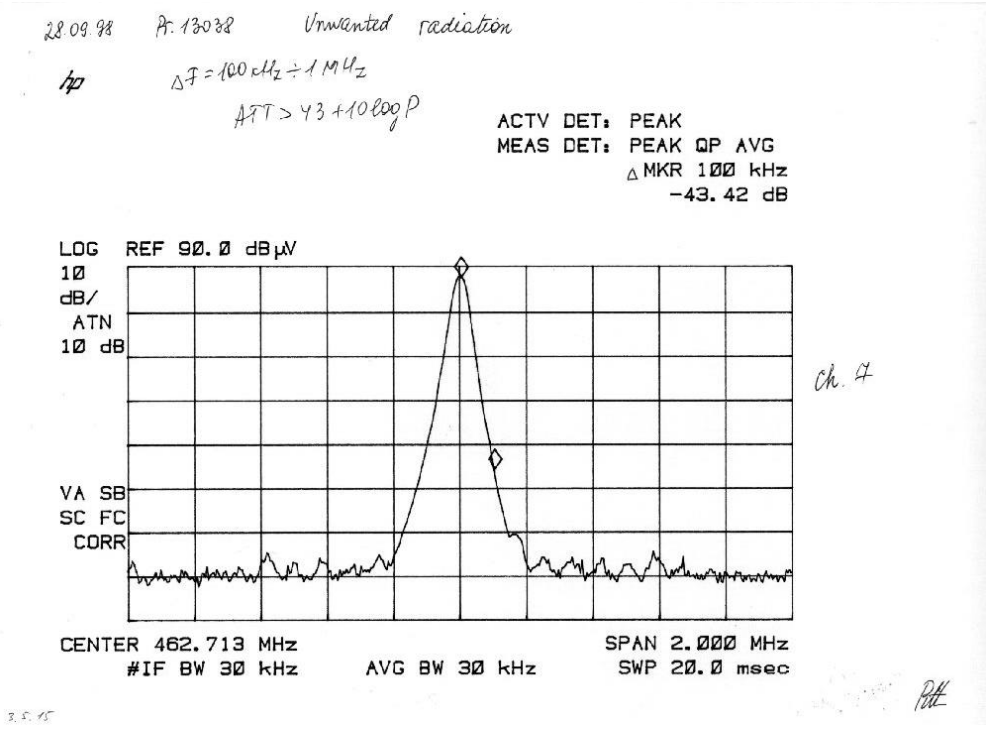
Plot 3.5.13
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



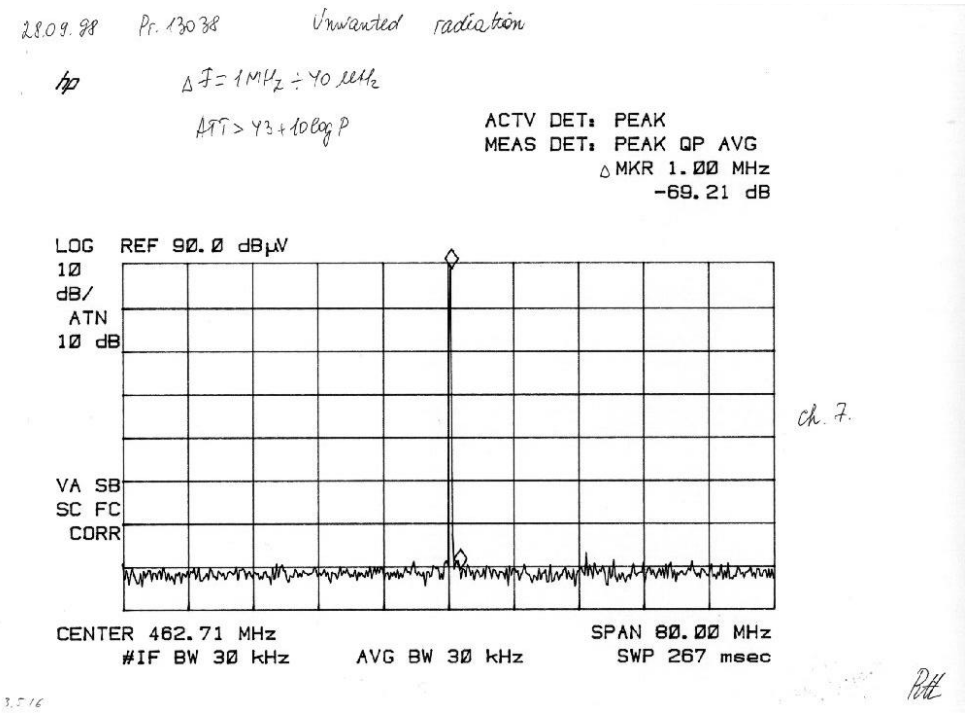
Plot 3.5.14
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



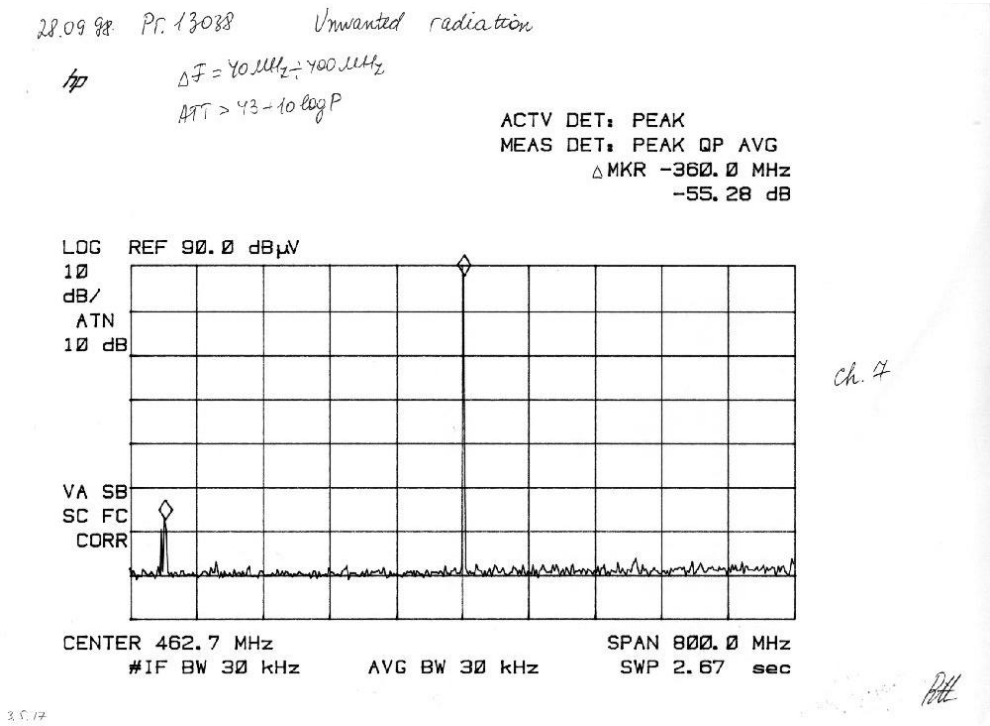
Plot 3.5.15
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



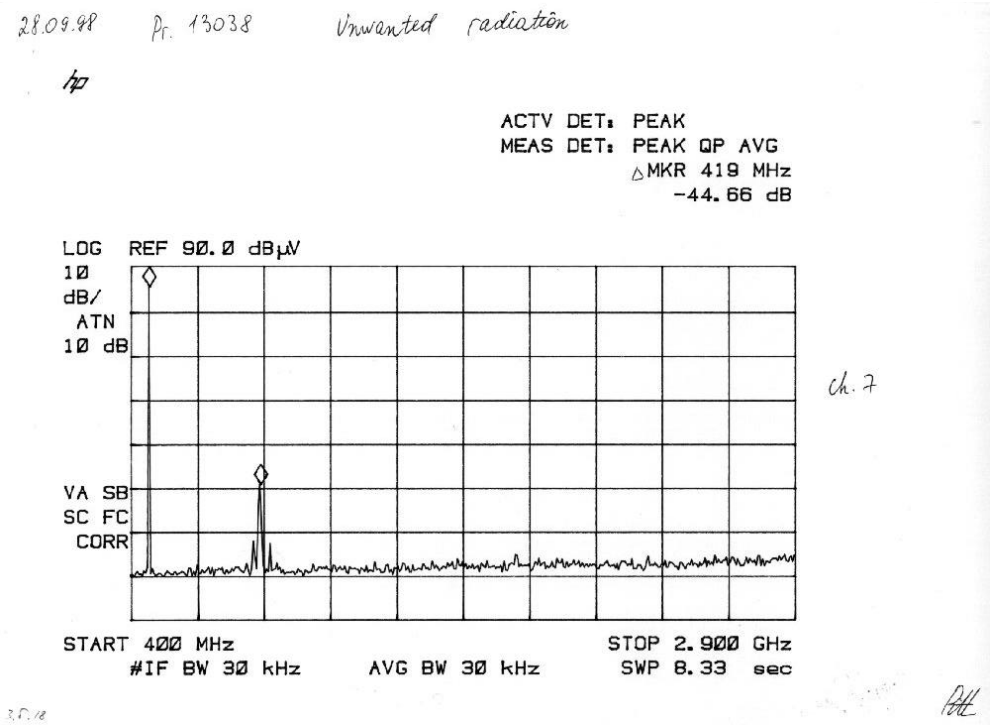
Plot 3.5.16
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



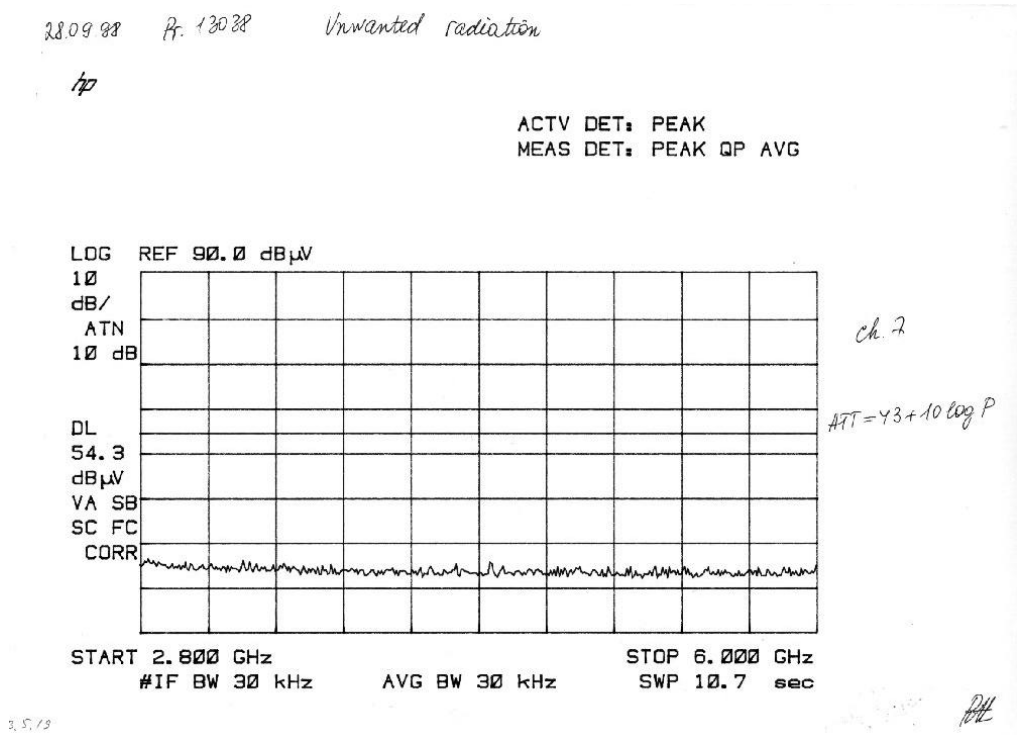
Plot 3.5.17
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



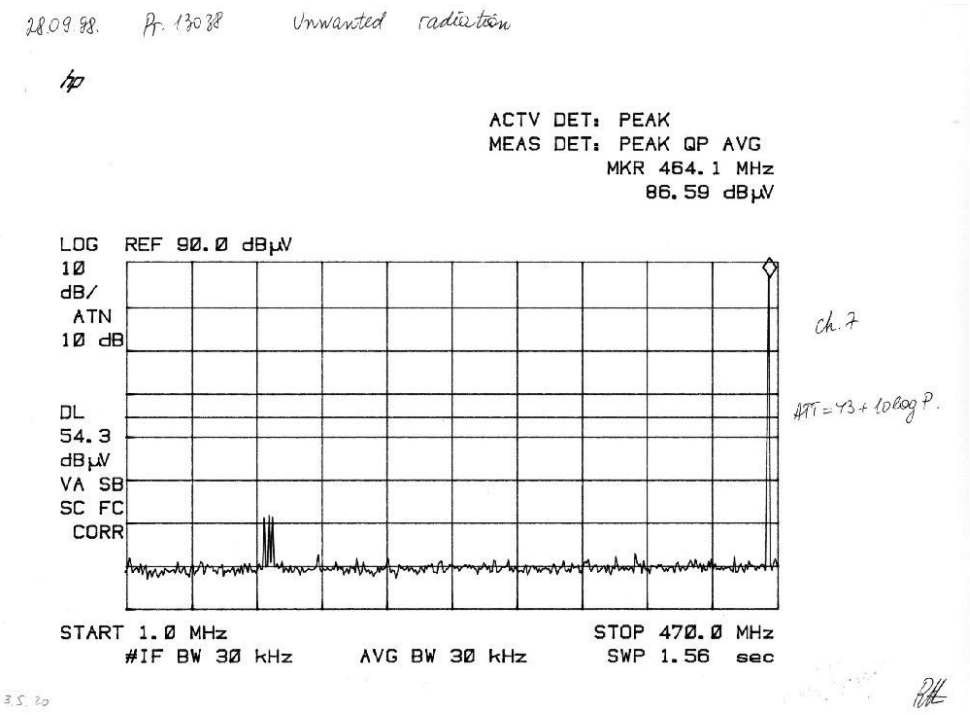
Plot 3.5.18
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



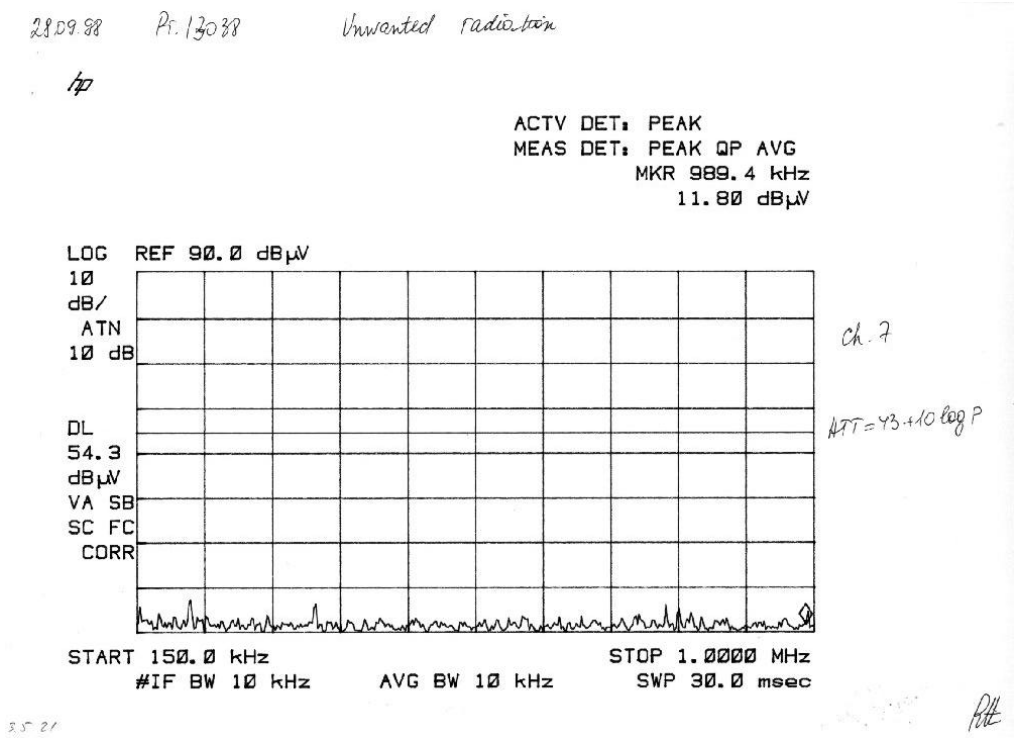
Plot 3.5.19
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



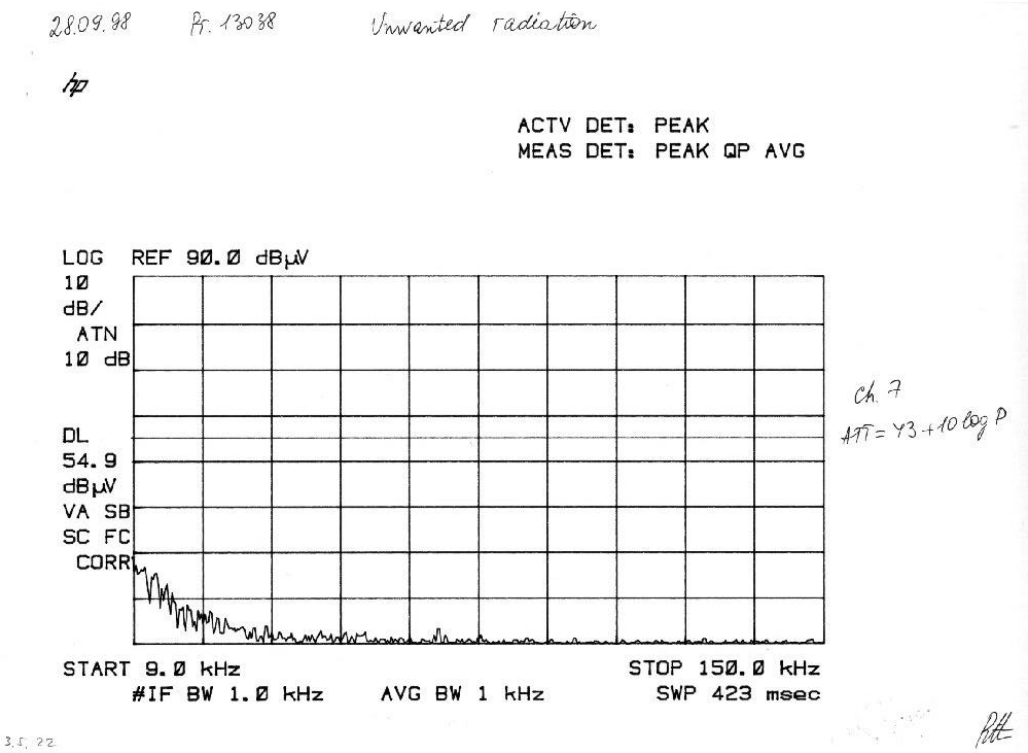
Plot 3.5.20
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



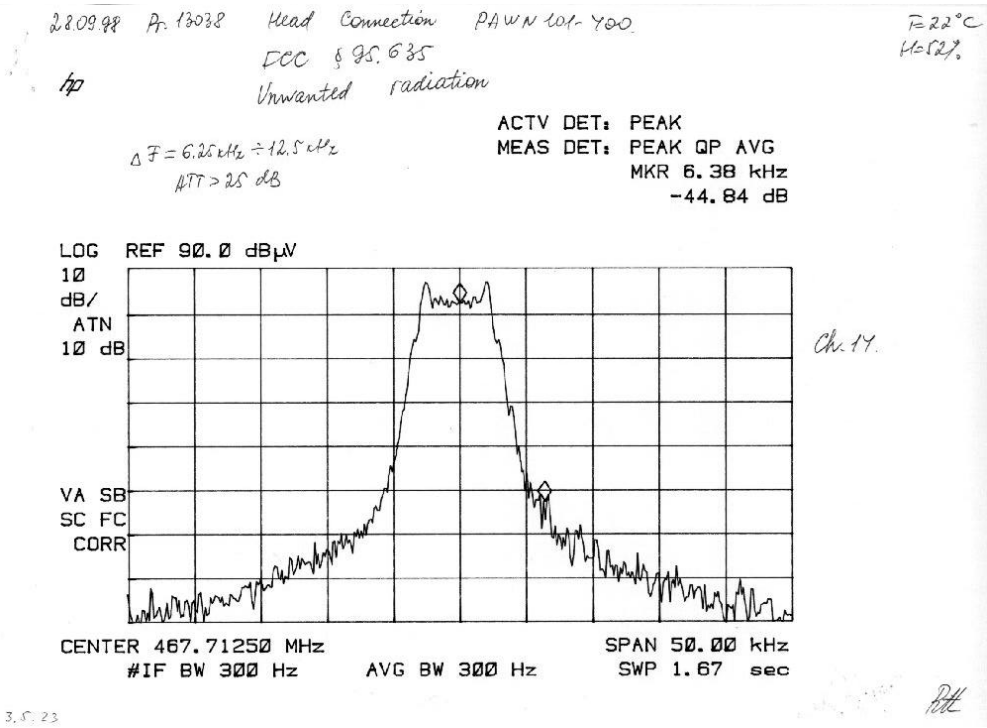
Plot 3.5.21
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



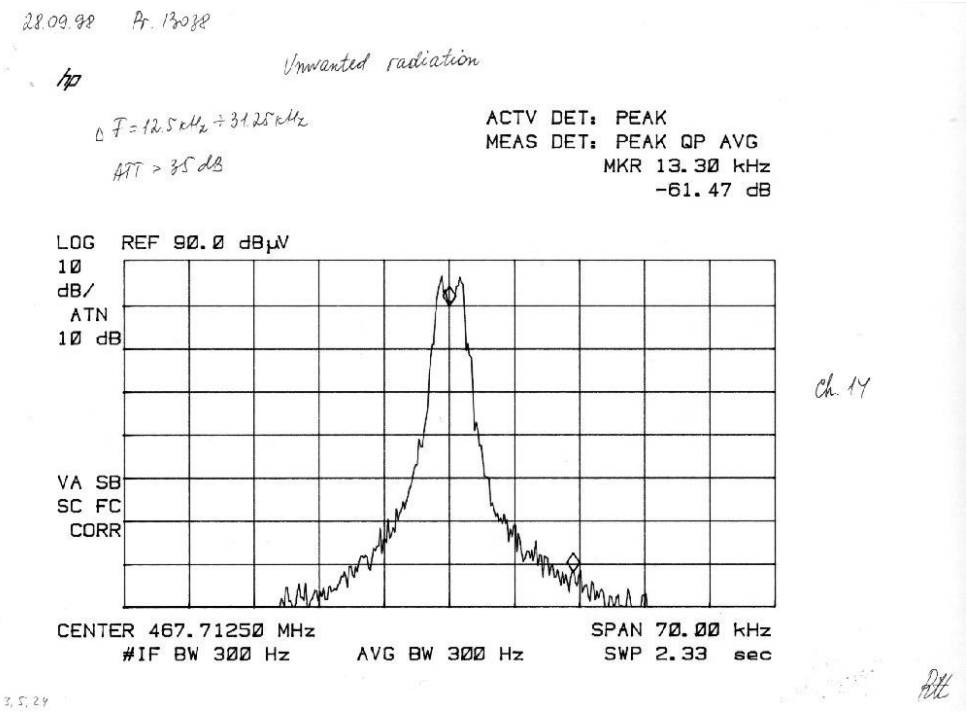
Plot 3.5.22
Unwanted radiation attenuation test results
@ 462.7125 MHz channel frequency



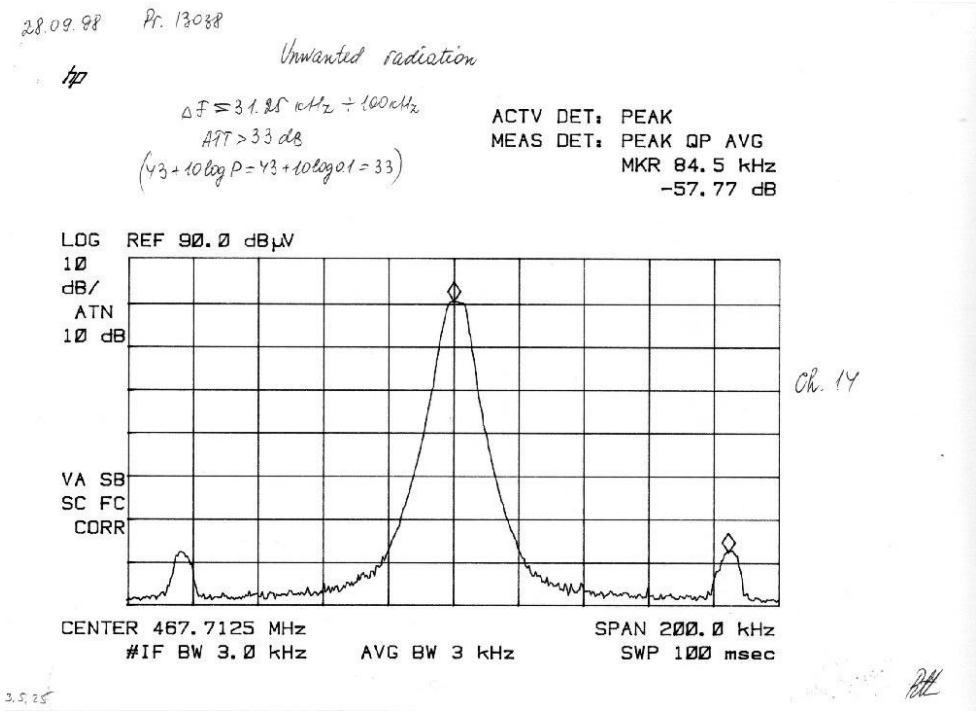
Plot 3.5.23
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



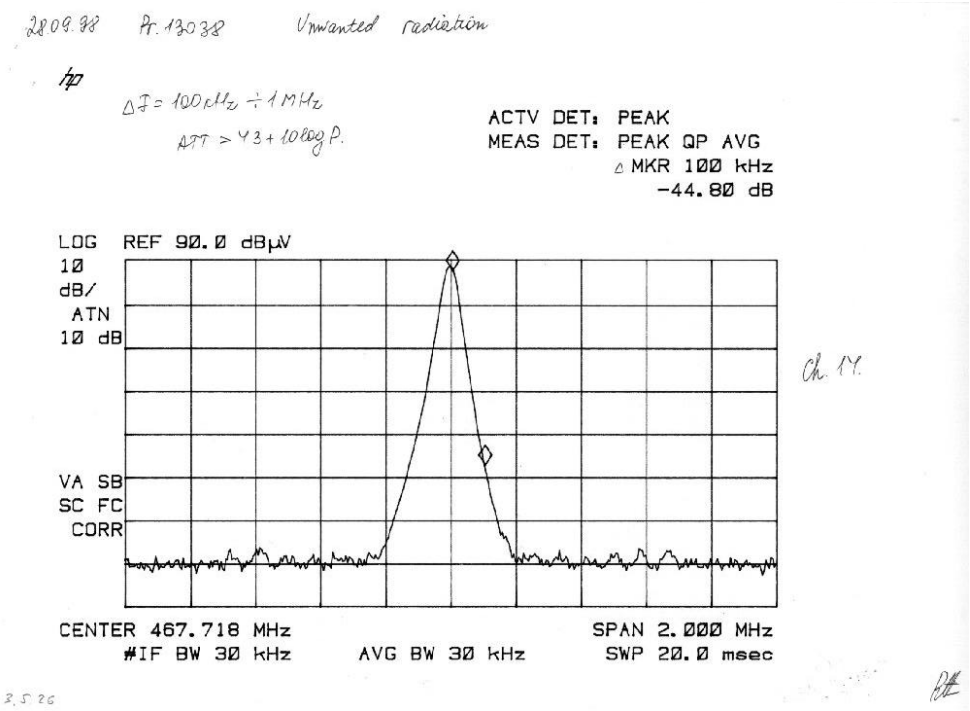
Plot 3.5.24
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



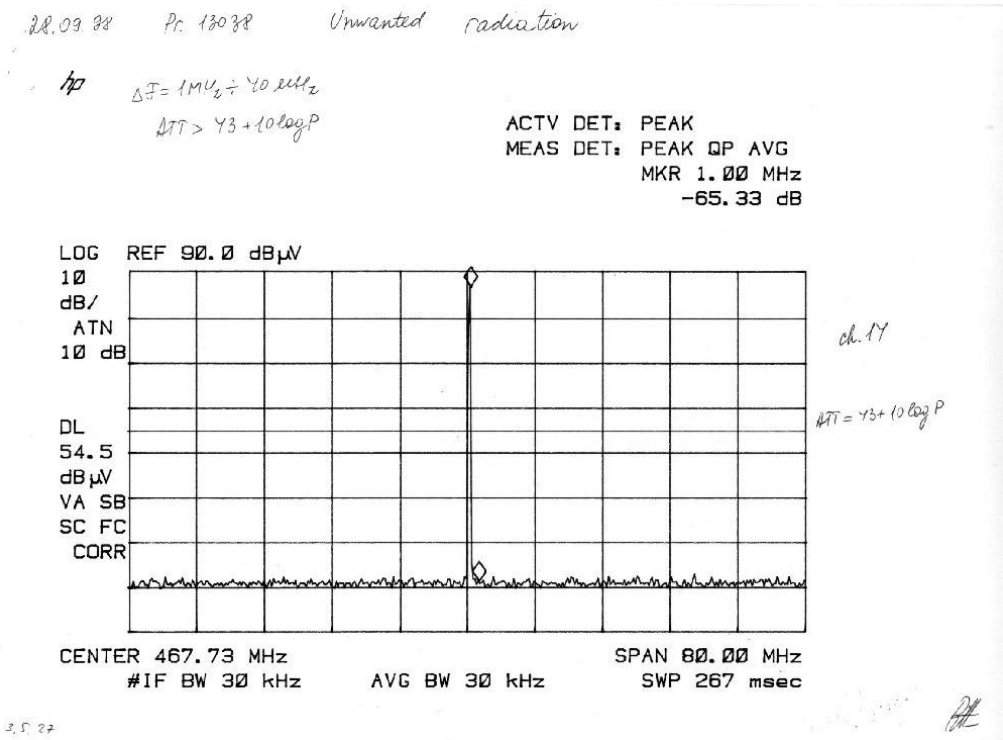
Plot 3.5.25
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



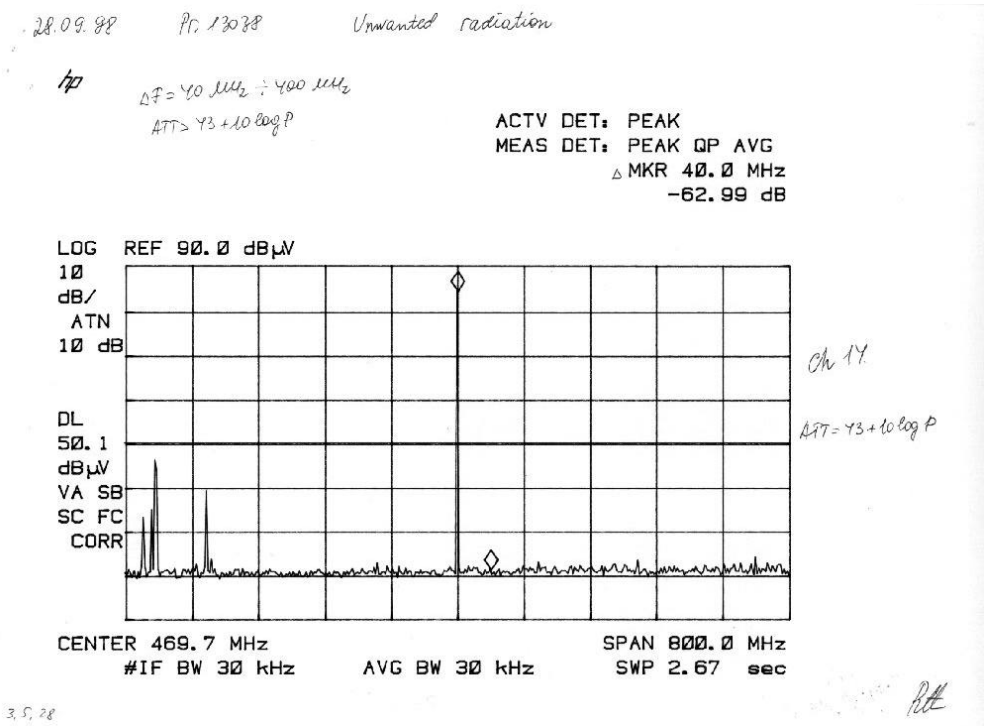
Plot 3.5.26
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



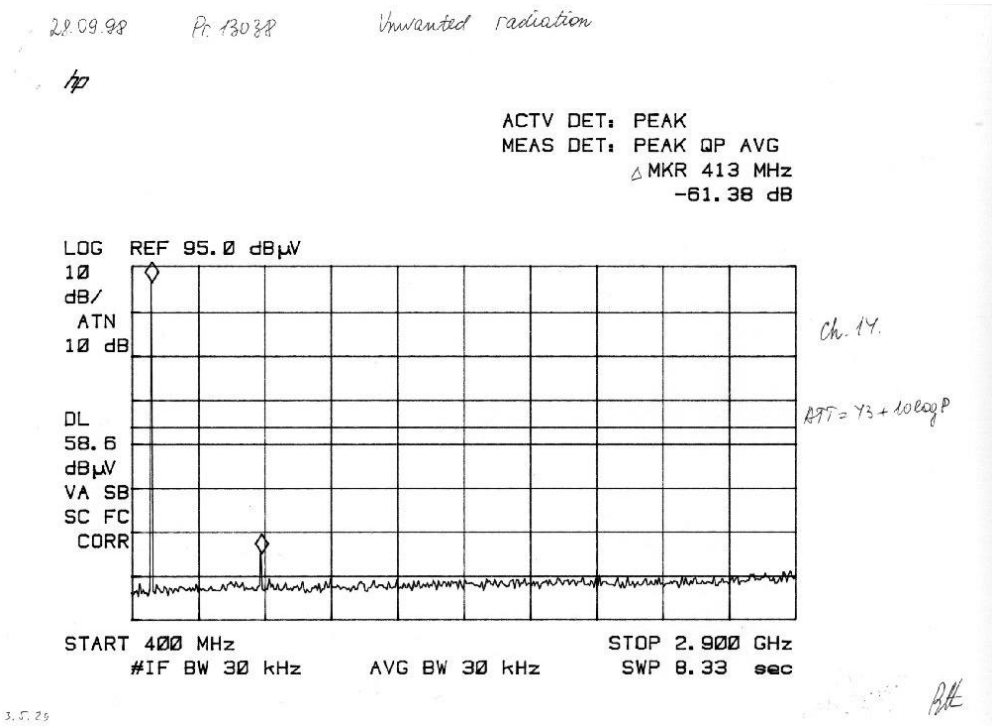
Plot 3.5.27
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



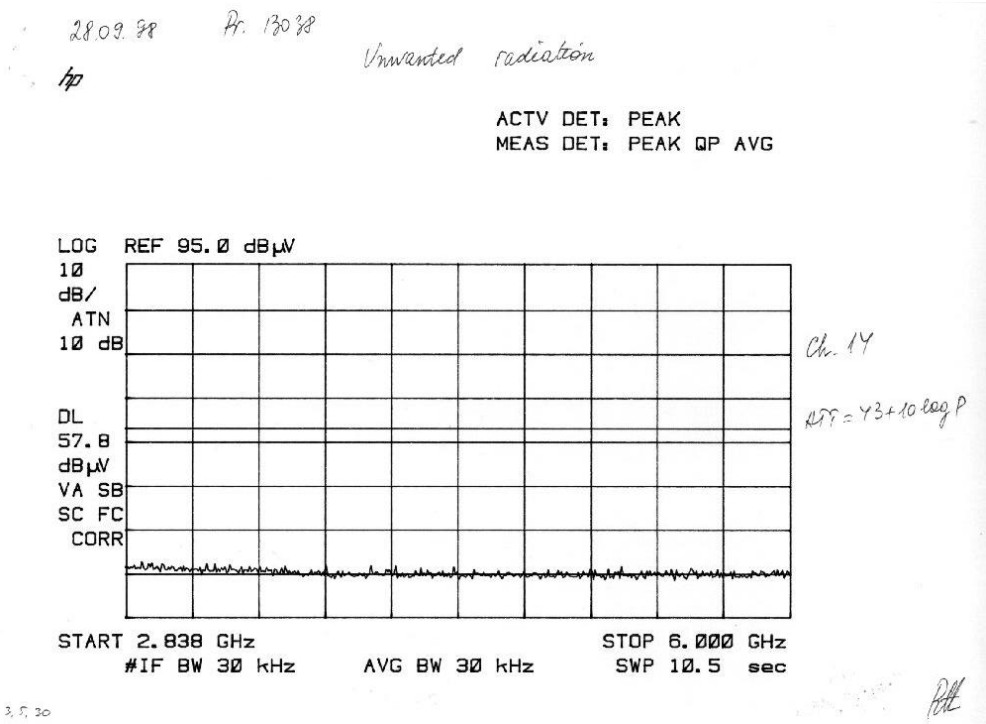
Plot 3.5.28
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



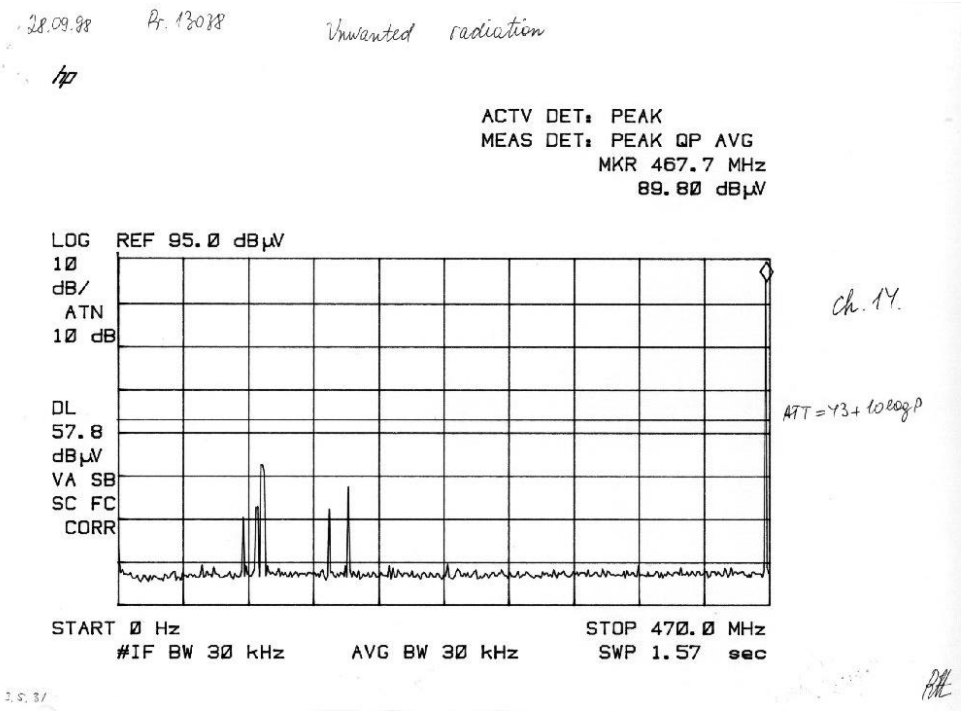
Plot 3.5.29
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



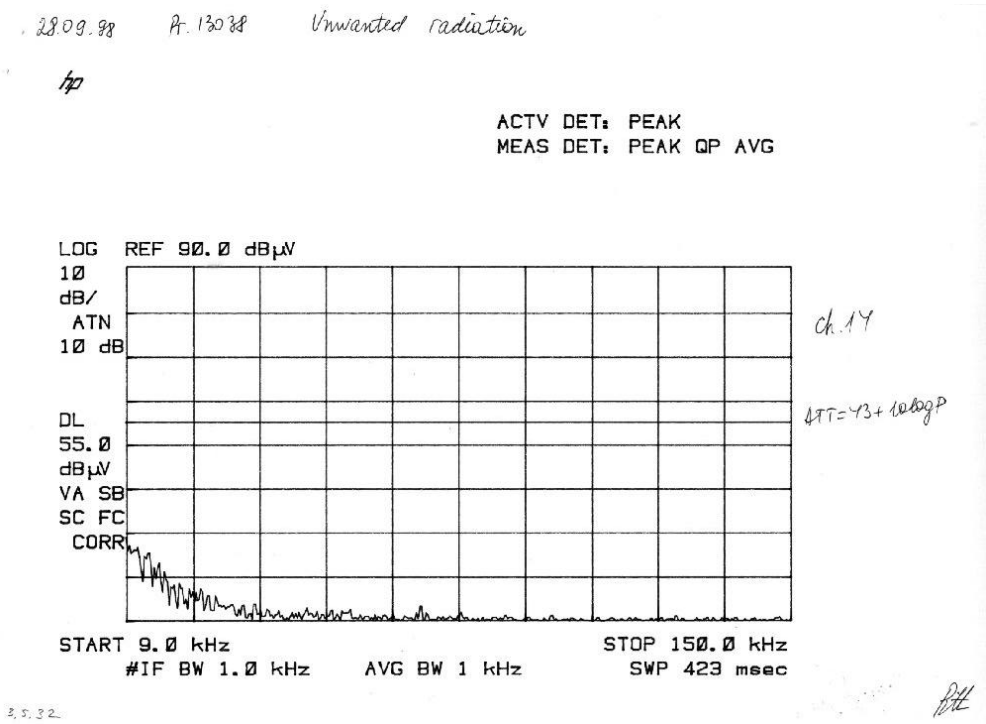
Plot 3.5.30
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



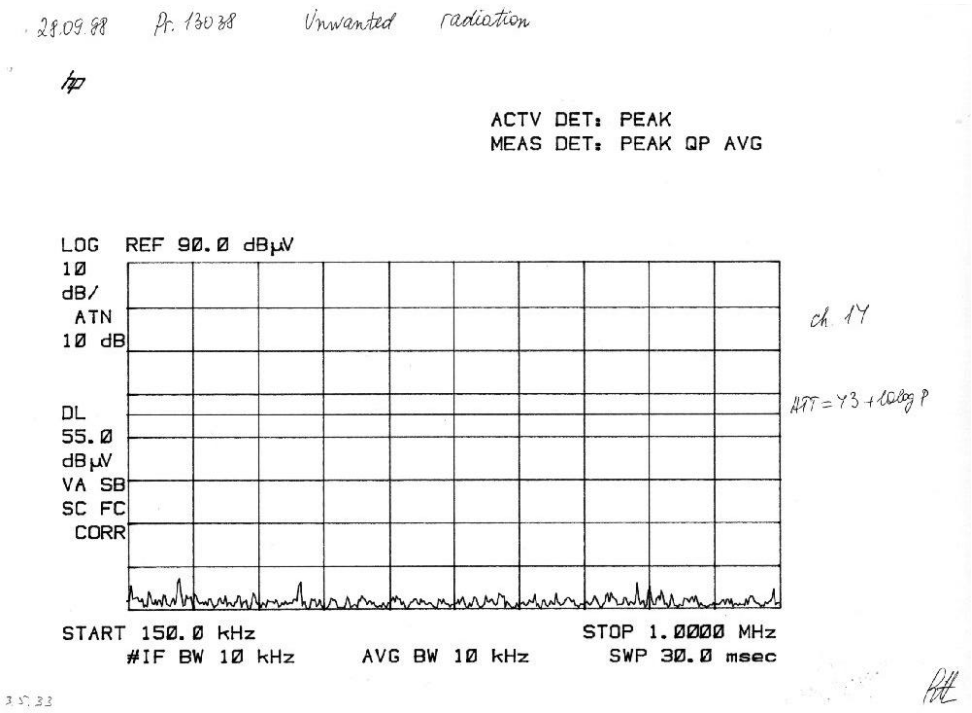
Plot 3.5.31
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



Plot 3.5.32
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



Plot 3.5.33
Unwanted radiation attenuation test results
@ 467.7125 MHz channel frequency



3.6 Field strength of spurious radiation test according to Part 95, §95.635 and Part 2, §2.993

3.6.1 Definition of the test

This test was performed to determine that the power of each unwanted emission should be attenuated below the transmitted power of the unmodulated carrier (P) as follows:

(4) On any frequency removed from the center of the authorized bandwidth by more than 50% up and including 100% of the authorized bandwidth (6.25 kHz – 12.5 kHz) at least 25 dB;

(5) On any frequency removed from the center of the authorized bandwidth by more than 100% up and including 250% of the authorized bandwidth (12.5 kHz – 31.25 kHz) at least 35 dB;

(6) On any frequency removed from the center of the authorized bandwidth by more than 250% (31.25 kHz) according to the equation [43 + 10log (carrier power P in watts)] dB = =33 dB at maximum ERP=0.1 W.

3.6.2 Test set-up

The EUT was tested according to the substitution method with dipole antenna. The radiated emissions measurements were performed with the biconical, log periodic and double ridged guide antennas, installed on the variable height antenna mast in the Hermon Laboratories open field test site at 3 meters measuring distance. The EUT was installed on the 0.8 m high wooden table which was on the top of the metal turntable flush mounted with the ground plane. To find the maximum radiation measuring antenna height was changed from 1 to 4 m, the turntable was rotated 360° and the antennas polarization was changed from vertical to horizontal.

3.6.3 Test results

To determine the spurious emissions power the test was performed with the transmitter operating with modulation at 3 carrier channel frequencies: 462.5625 MHz, 462.7125 MHz and 467.7125 MHz. The frequency range from 9 kHz to 5 GHz was investigated. The spurious radiation attenuation results were obtained from the equation:

$$\text{Attenuation (dB)} = ERP_{max}\ (\text{dBm}) - P_{spurious}\ (\text{dBm})$$

where

$ERP_{max} =$ 19.1 dBm

the spurious radiation power $P_{spurious}$ (dBm) = $P_{out\ gen}$ - Cable loss + Antenna gain

The results of measurements were recorded in Table 3.6.1.

Reference numbers of test equipment used

HL 0027	HL 0034	HL 0038	HL 0041	HL 0275	HL 0287	HL 0557
HL 0614	HL 0661					

Full description is given in Appendix A.

Table 3.6.1 Field strength of spurious radiation measurement test results

TEST SPECIFICATION:	FCC part 95, §95.635
COMPANY:	Head Connection Systems Ltd.
EUT:	PAWN 101-460
DATE:	September 17, 1998
RELATIVE HUMIDITY:	57%
AMBIENT TEMPERATURE:	24°C

MEASUREMENTS PERFORMED AT 3 METRES DISTANCE

Frequency MHz	Generator P out dBm	Antenna Gain dB	Cable Loss dB	$P_{spurious}$ dBm	Attenuation dB	Attenuation Specified Limit dB	Spec. Margin dB	Pass/ Fail
925.125	-33	1.8	3.0	-34.2	53.3	33	20.3	Pass
925.425	-34	1.8	3.0	-35.2	54.3	33	21.3	Pass
935.425	-35	1.8	3.0	-36.2	55.3	33	22.3	Pass

Test parameters:
The listed test results were obtained at the following conditions:
Detector type = peak
Resolution bandwidth = 120 kHz
Antenna type – log periodic
Antenna polarization - vertical

Table calculations and abbreviations:
$P_{spurious} = P_{out\ gen}$ - Cable loss (dB) + Antenna gain (dB)
Attenuation (dB) = ERP (dBm) – $P_{spurious}$ (dBm)
Spec. margin = specification margins = dB below (negative if above) specification limit.

Test performed by:
Mrs. Eleonora Pitt, test engineer

Hermon Labs

3.7 Modulation standards test according to Part 95, §95.637(a) and Part 2, §2.987(a)

3.7.1 Definition of the test

This test was performed to determine that the EUT should not exceed a peak frequency deviation of plus or minus 2.5 kHz, and the audio frequency response should not exceed 3.125 kHz.

3.7.2 Test set-up

The test setup is shown in Photograph 3.7.1. The 1000 Hz tone at 100 dB SPL (sound pressure level) was applied 10 cm from the EUT microphone. The measurements were performed to show a peak frequency deviation and frequency response throughout the 100 – 5000 Hz range of modulating frequencies.

3.7.3 Test results

The measurements were performed for 3 channel frequencies. The transmitter modulation signal was changed from 100 Hz to 5 kHz and the modulation curve was plotted as shown in Table 3.7.1. The EUT passed the test requirements.

Reference numbers of test equipment used

HL 0133	HL 0279	HL 0693	HL 0793			

Full description is given in Appendix A**.**

Table 3.7.1 Modulation characteristics measurement test results

TEST SPECIFICATION: FCC part 95, §95.637(a)
COMPANY: Head Connection Systems Ltd.
EUT: PAWN 101-460
DATE: November 1, 1998
RELATIVE HUMIDITY: 57%
AMBIENT TEMPERATURE: 23°C

Modulating frequency, kHz	Measured deviation, kHz @ carrier channel frequency, MHz			Pass/Fail
	462.5625	462.7125	467.7125	
0.4	0.2	0.2	0.2	Pass
0.5	0.8	0.7	0.7	Pass
0.6	0.9	1.0	0.8	Pass
0.7	0.9	0.8	0.9	Pass
1.0	0.9	0.7	0.9	Pass
1.5	1.0	1.0	1.0	Pass
1.8	1.3	1.2	1.3	Pass
2.0	1.8	1.2	1.8	Pass
2.5	1.7	1.3	1.7	Pass
2.9	1.9	1.4	1.9	Pass
3.0	0.8	0.7	2.0	Pass
3.1	0.4	0.4	0.4	Pass
3.2	0.4	0.4	0.4	Pass
3.5	0.4	0.4	0.4	Pass
3.8	0.4	0.4	0.4	Pass
4.0	0.4	0.4	0.4	Pass
4.3	0.2	0.2	0.2	Pass
4.7	0.1	0.1	0.1	Pass
5.0	0.0	0.0	0.0	Pass

Test performed by:
Mrs. Eleonora Pitt, test engineer

Hermon Labs

Photograph 3.7.1
Modulation characteristics measurement test setup

3.8 Unintentional Radiated emissions (class B digital device) test according to Part 15, §15.109

3.8.1 Definition of the test

This test was performed to measure radiated emissions from the receiver and incorporated digital device of the EUT.

3.8.2 The test set-up configuration

The radiated emissions measurements of the EUT receiver and incorporated digital device in the frequency range from 30 MHz to 2 GHz were performed in the anechoic chamber at 3 meters measuring distance. The EUT was placed on the wooden table as shown in Figure 3.8.1.
The biconilog antenna was used. To find maximum radiation the turntable was rotated 360°, the cables position was varied, the measuring antenna height changed from 1 to 4 m, and the antennas polarization was changed from vertical to horizontal. The measurements from 30 MHz to 1 GHz were performed with EMI receiver settings: RBW=120 kHz, quasi-peak detector. The receiver radiated emission measurements from 1 GHz up to 2 GHz were performed with the spectrum analyzer settings: RBW=VBW=1 MHz, peak detector.

The EUT was found to be in compliance with §15.109 class B limits. No signals from the EUT were found above 1 GHz. The results of measurements are shown in Plots 3.8.1, 3.8.2.

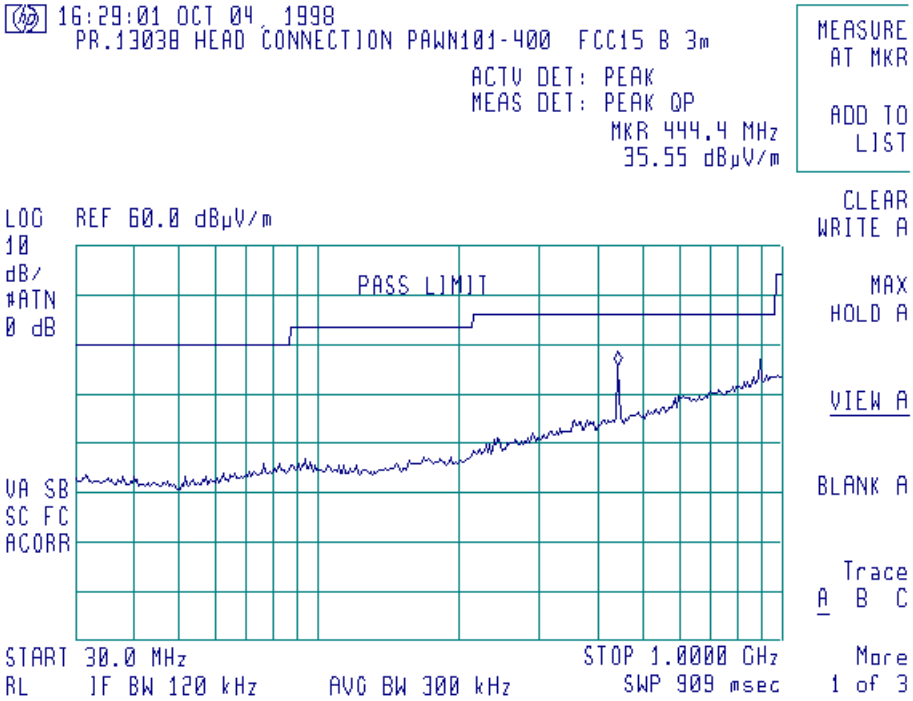
Reference numbers of test equipment used

HL 0275	HL 0465	HL 0521	HL 0593	HL 0594	HL 0604	HL 0815
HL 0816						

Full description is given in Appendix A.

Plot 3.8.1

Test Specification: § 15.109, class B
Radiated emissions of receiver and incorporated digital device test



Signal No.	Frequency MHz	Peak Amplitude dB(uV/m)	QP Amplitude dB(uV/m)	Specified Margin dB	Specified Limit dB(uV/m)	Corrections dB
1	444.661750	43.26	40.68	-5.32	46	19.30
2	889.319000	36.46	31.51	-14.49	46	27.19

Plot 3.8.2

Test Specification: § 15.109, class B
Radiated emissions of receiver

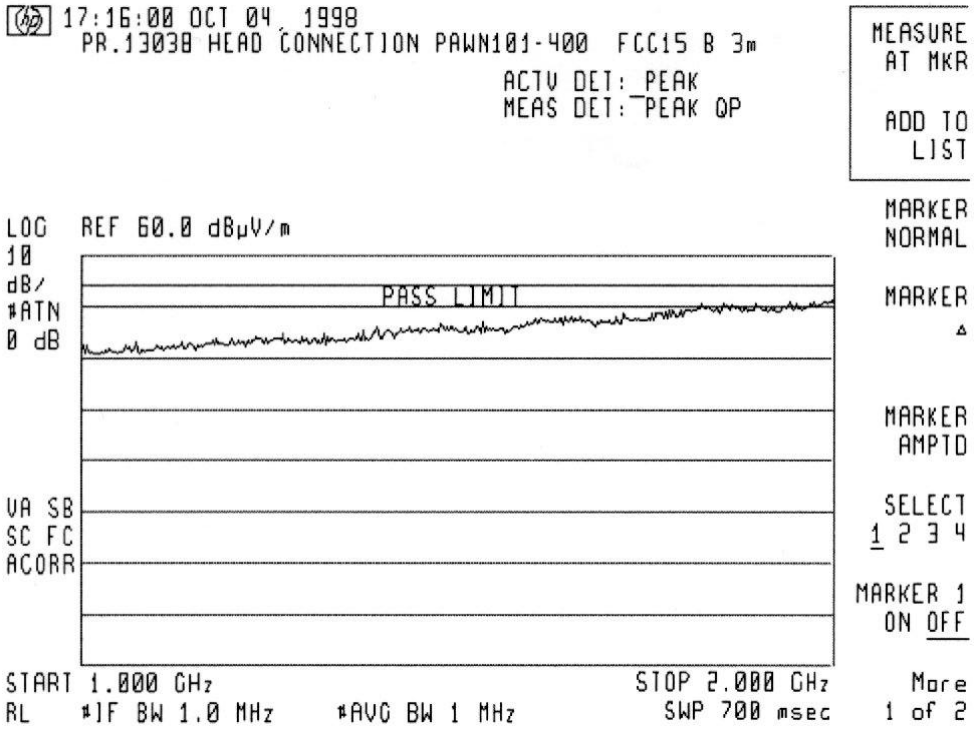
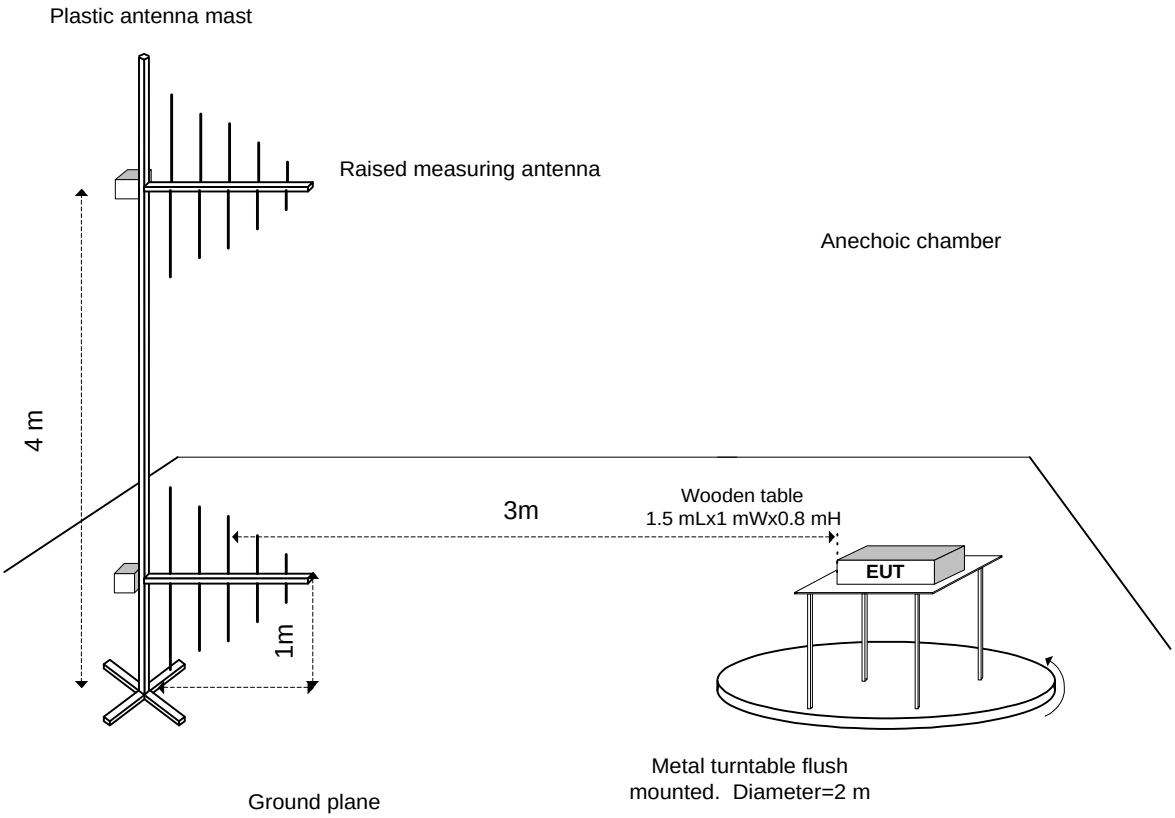
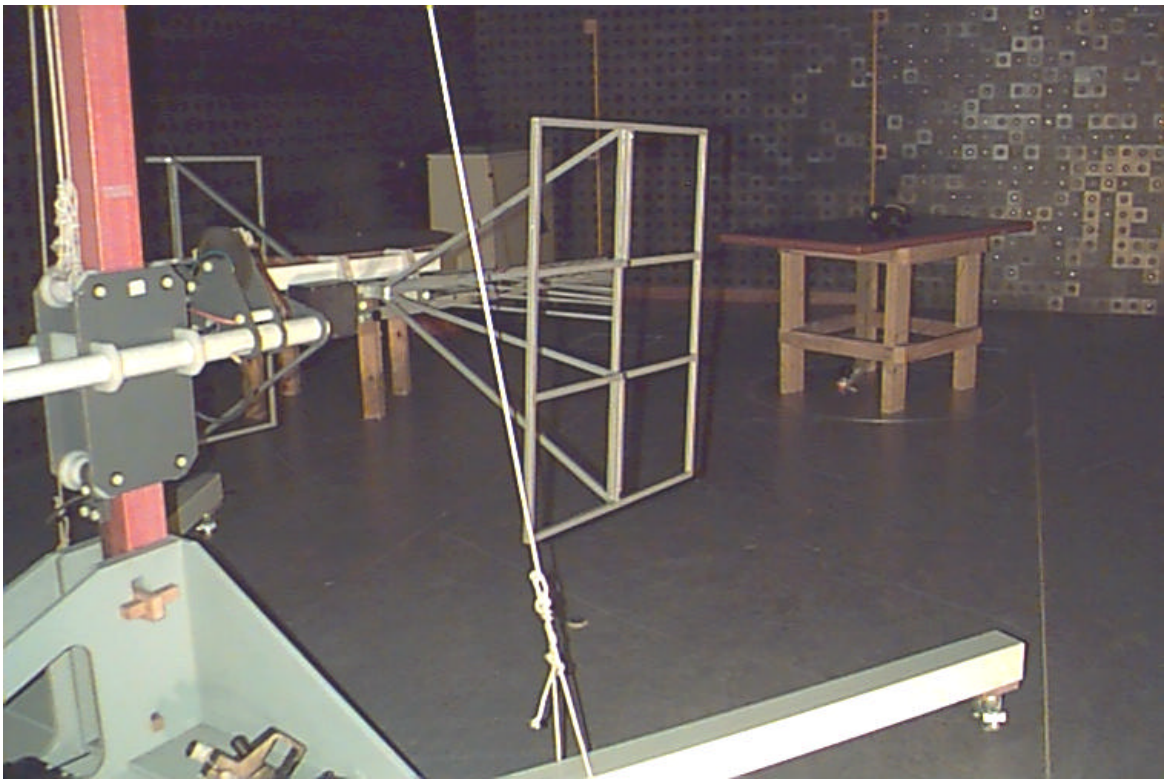


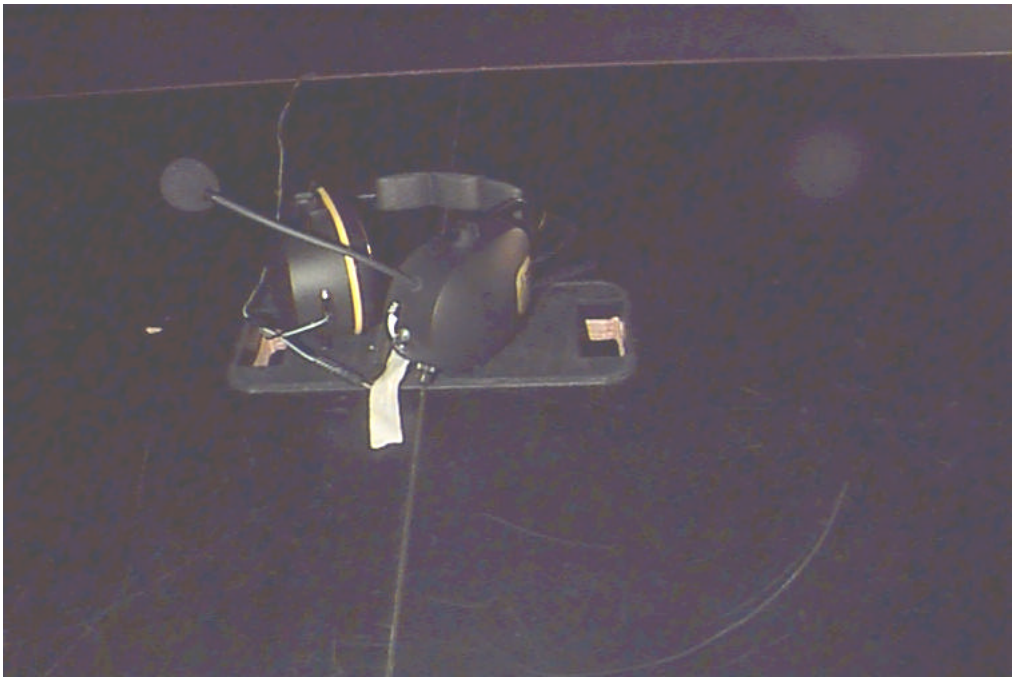
Figure 3.8.1
Radiated emission test setup



Photograph 3.8.1
Radiated emission measurement test setup



Photograph 3.8.2
Radiated emission measurement test setup



3.9 Conducted Emission Measurements according to Part 15, §15.107, §15.207

3.9.1 Definition of the test

This test was performed to measure conducted emissions.

3.9.2 Test set-up

The test was performed in the shielded room. The EUT was setup as shown in Figures 3.9.1, 3.9.2.

The frequency range from 450 kHz to 30 MHz was investigated.

The measurements were performed on the adapter 120 V AC power lines (both neutral and phase) by means of the LISN, connected to the spectrum analyzer. The unused 50 Ω connector of the LISN was resistively terminated in 50 Ω when not connected to the measuring instrument. The peak detector (resolution bandwidth = 10 kHz) was used. All the measured emissions were found at least 20 dB below limit. The test results are shown in Plot 3.9.1.

Reference numbers of test equipment used

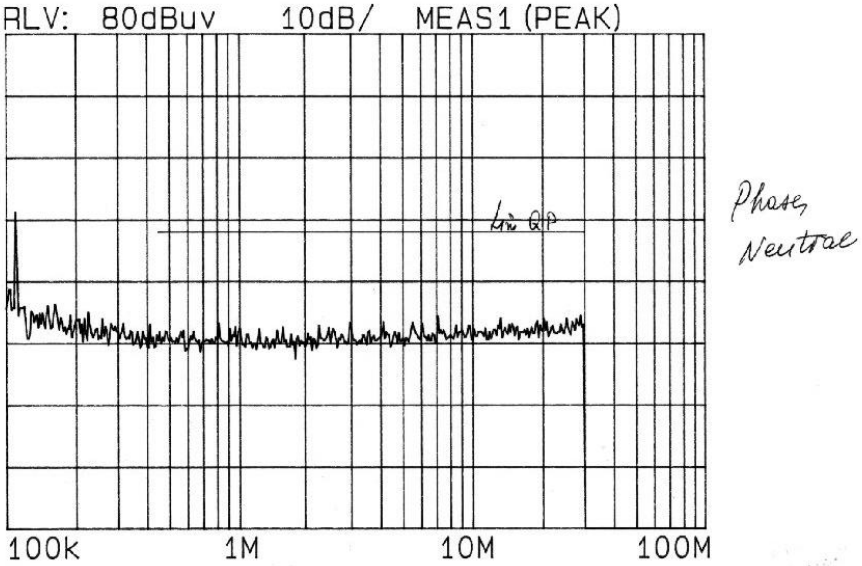
HL 0026	HL 0163	HL 0185	HL 0466	HL 0817		

Full description is given in Appendix A.

Plot 3.9.1

Test Specification: § 15.107, § 15.207, class B
Conducted Emission Measurements on power line
Frequency range: 450 kHz-30 MHz
Line: phase
Detector: peak

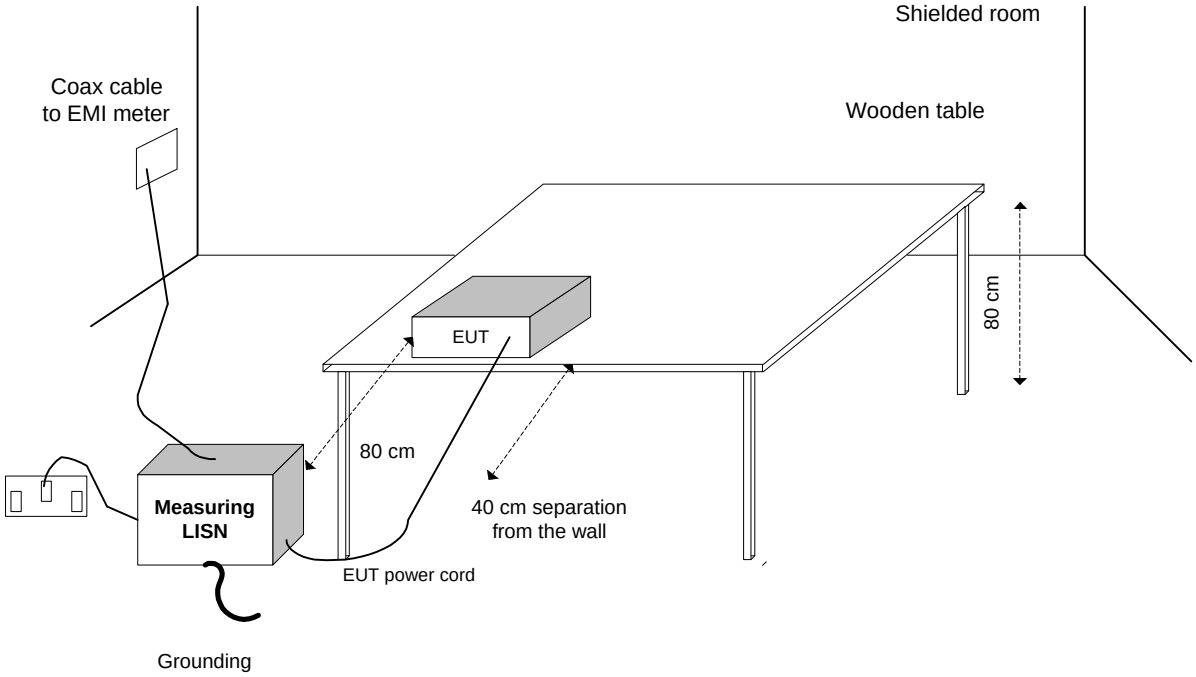
8.11.98 Ar. 13038 Head Connection PAWN 101-400. T=27°c
For T.R. FCC p 15 cl.B. Conducted Emission H=57%



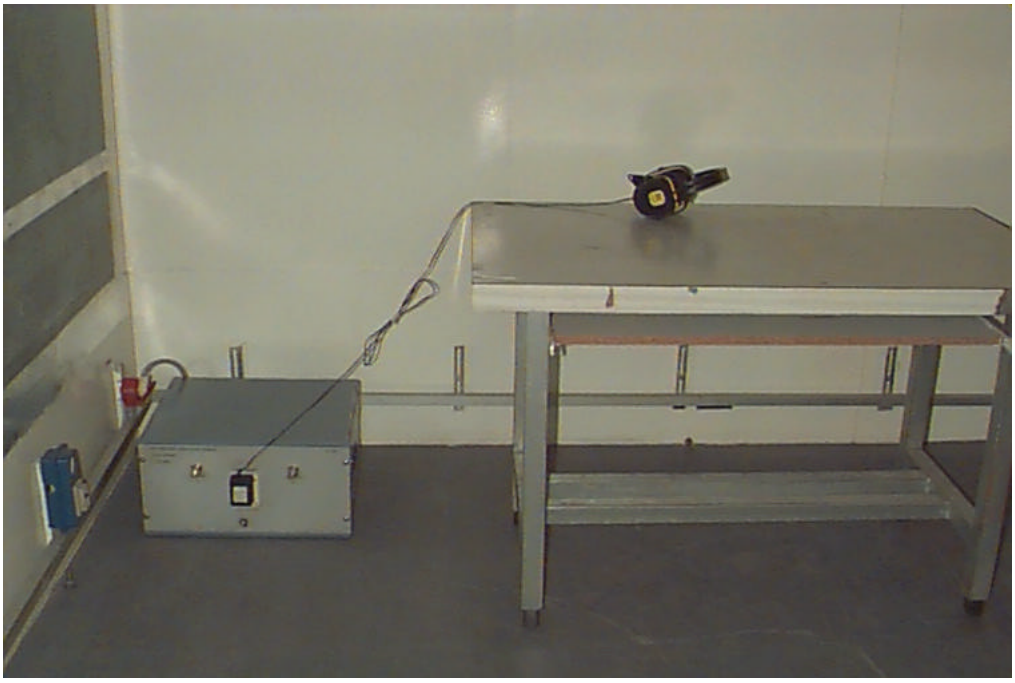
Phase, Neutral

3.8.1

Figure 3.9.1.
Conducted emission test setup



Photograph 3.9.1.
Conducted emission test setup



Photograph 3.9.2.
Conducted emission test setup

4 Summary and Signatures

The EUT, PAWN 101-460, was found to be in compliance with the requirements of FCC Part 2, §§2.987, 2.989, 2.991, 2.993, 2.995, 2.997, Part 95, §§95.627, 95.631, 95.633, 95.635, 95.637, 95.639 and within Part 15, §§15.107, 15.109, 15.207 class B limits.

Test performed by:

Mrs. Eleonora Pitt, test engineer ___ ___

Approved by:

Dr. Edward Usoskin, C.E.O. _

Responsible person from
Head Connection Systems Ltd.

Mr. Yoram Peled, marketing manager __ _

APPENDIX A - Test equipment and ancillaries used for tests

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0026	3460	Spectrum Analyzer, 100 Hz-2.2 GHz	Anritsu	MS 2601A	8/99
0027	4838	Spectrum Analyzer, 50 Hz-2 GHz	Anritsu	MS-611A	10/99
0034	1988	Log Periodic Antenna, 200 - 1000 MHz	Electro-Metrics	LPA 25/30	4/99
0038	028	Antenna Mast, 1-4 m	Hermon Labs	AM-1	2/00 Check
0041	2811	Double Ridged Guide Antenna, 1 - 18 GHz	Electro-Metrics	RGA 50/60	8/99
0129	4119	Generator Oscillator, 10 Hz – 1 MHz	Hewlett Packard	4204A	9/99
0133	3551	Generator Audio, 5 Hz – 600 kHz	Hewlett Packard	HP, 200CDR	2/00
0163	1314	LISN, 9kHz-100MHz	Electro-Metrics	ANS-25/2	11/99
0185	1765	Graphics Plotter	Hewlett Packard	7475A	NA
0275	040	Table non-metallic, adjustable height, 1.5 x 1.0 x 0.8 m	Hermon Labs	TNM	3/00 Check
0279	279	Transformer, impedance matching, 2.4/50 Ohm	Solar Electronics	7033-1	10/99
0287	042	Turntable, Motorized Diameter, 2m	Hermon Labs	TMD-2	4/99
0465	023	Anechoic Chamber 9 (L) x 6.5 (W) x 5.5 (H) m	Hermon Labs	AC-1	10/99
0466	024	Shielded Room 3 (L) x 3 (W) x 2.4 (H) m	Hermon Labs	SR-1	5/99 Check
0500	2893-05	Oven temperature	Thermotron	S-16 Mini-Max	11/99
0521	3617A 00319	Analyzer, Spectrum with RF filter section - HP EMI Receiver 9 kHz - 8 GHz	Hewlett Packard	HP 8546A	7/99
0557	112225 /080	Generator Signal	Marconi Instruments	52023-002E	11/99
0593	101	Antenna Mast, 1-4 m/ 1-6 m Pneumatic	Hermon Labs	AM-F1	4/99
0594	102	Turntable for Anechoic Chamber, flush mounted, d=1.2 m, pneumatic	Hermon Labs	WDC1	11/99
0604	1011	Antenna Biconilog Log-Periodic/T Bow-Tie, 26 - 2000 MHz	EMCO	3141	7/99
0614	334	Antenna Dipole, Tunable, 200 - 1000 MHz	Electro-Metrics	TDS 30/1	2/00

HL Serial No.	Serial No.	Description	Manufacturer	Model No.	Due Calibr.
0661	0266	Generator Swept Signal, 10MHz to 40GHz+ 10dBm	Hewlett Packard	83640B	5/99
0693	0863	Precision Sound level Meter	Bruel & Kjaer	2232	7/00
0792	2006	Series Microwave EMI Measurement System, 1 – 26.5 GHz	Hewlett Packard	84125	8/99
0793	9507/ 179	Radio Communications Test Set	Marconi Instruments	2955	9/99
0815	151	Cable, coax, RG-214, 7.3 m, N-type connectors, inside anechoic chamber	Hermon Labs	C214-7	8/99
0816	152	Cable, coax, RG-214, 8 m, N-type connectors, outside anechoic chamber	Hermon Labs	C214-8	8/99
0817	153	Cable, coax, RG-58, 8 m, N-type connectors	Hermon Labs	C58-8	8/99

APPENDIX B-Test Equipment Correction Factors

Correction Factor
Line Impedance Stabilization Network
Model ANS-25/2
Electro-Metrics

Frequency, kHz	Correction Factor
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor dB is to be added to the meter readings (dB/µv) of the interference analyzer or spectrum analyzer.

Antenna Factor at 3 m test distance
Biconilog Antenna EMCO Model 3141
Ser.No.1011

Frequency, MHz	Antenna Factor, dB(1/m)	Frequency, MHz	Antenna Factor, dB(1/m)
26	7.8	940	24.0
28	7.8	960	24.1
30	7.8	980	24.5
40	7.2	1000	24.9
60	7.1	1020	25.0
70	8.5	1040	25.2
80	9.4	1060	25.4
90	9.8	1080	25.6
100	9.7	1100	25.7
110	9.3	1120	26.0
120	8.8	1140	26.4
130	8.7	1160	27.0
140	9.2	1180	27.0
150	9.8	1200	26.7
160	10.2	1220	26.5
170	10.4	1240	26.5
180	10.4	1260	26.5
190	10.3	1280	26.6
200	10.6	1300	27.0
220	11.6	1320	27.8
240	12.4	1340	28.3
260	12.8	1360	28.2
280	13.7	1380	27.9
300	14.7	1400	27.9
320	15.2	1420	27.9
340	15.4	1440	27.8
360	16.1	1460	27.8
380	16.4	1480	28.0
400	16.6	1500	28.5
420	16.7	1520	28.9
440	17.0	1540	29.6
460	17.7	1560	29.8
480	18.1	1580	29.6
500	18.5	1600	29.5
520	19.1	1620	29.3
540	19.5	1640	29.2
560	19.8	1660	29.4
580	20.6	1680	29.6
600	21.3	1700	29.8
620	21.5	1720	30.3
640	21.2	1740	30.8
660	21.4	1760	31.1
680	21.9	1780	31.0
700	22.2	1800	30.9
720	22.2	1820	30.7
740	22.1	1840	30.6
760	22.3	1860	30.6
780	22.6	1880	30.6
800	22.7	1900	30.6
820	22.9	1920	30.7
840	23.1	1940	30.9
860	23.4	1960	31.2
880	23.8	1980	31.6
900	24.1	2000	32.0
920	24.1		

Antenna factor is to be added to receiver meter reading in dB(µV) to convert to field intensity in dB(µV/meter).

APPENDIX C- A2LA Accreditation

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC GUIDE 25-1990 (EN 45001)

HERMON LABORATORIES
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Binyamina 30550, Israel
Edward Usoskin Phone: 972 6 6288 001

ELECTRICAL (EMC)

Valid to: May 31, 1999 Certificate Number: 0839-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Electromagnetic Compatibility
- Radiated Emissions Tests
- Conducted Emissions Tests

Product Safety Testing
- Heat Resistance
- Impulse
- Clearance & Creepage Distance
- Temperature Rise
- High Current Arching Ignition
- Bonding Resistance
- Flammability
- Overload
- Leakage Current
- Hot Wire Ignition
- Dielectric Withstanding

Telecommunications Testing
- Longitudinal Balance
- Environmental Stresses, Surges
- DTMF & Pulse Dialing
- On Hook, Off Hook DC/AC Impedances
- In-Band, Out of Band Signals
- Return Losses
- Hazardous Voltages
- Hearing Aids
- Billing Protection

On the following equipment:
Information Technology Equipment (ITE); Industrial, Scientific and Medical Equipment (ISM); Telecommunications Equipment; Electrical Appliances; Portable Tools; Motors; Transformers; and Similar Electrical Apparatus

Using the following test methods/specifications/standards:
FCC Part 15 using ANSI C63.4 - 1992
ANSI/UL 1950 - 1994
AS 3260
AS/NZS 1044, AS/NZS 2064, AS/NZS 3548
CISPR 11 - 1990, CISPR 14, CISPR 22 - 1993
EN 55011 - 1991, EN 55014 - 1987, EN 55022 - 1994, EN 60950 - 1993
IEC 950 - 1996
Israeli Ministry of Communications Specification No. 023/96
TS 001, TS 002, TS 004
US Code of Federal Regulation (CFR) 47 Parts 15, 18, and 68

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