

Nemko Comlab AS

Office address: Gåsevikveien 8, Kjeller
Postal address: P.O.Box 96, N-2027 Kjeller
Telephone: +47 64 84 57 00
Facsimile: +47 64 84 57 05
E-mail: post@comlab.no
http://www.comlab.no
Enterprise no: NO 984 592 418 MVA

No of Pages : 37

Test report : 52320-10
Item tested : WorldPro 1000
Type of equipment : Frequency Hopping Transmitter
FCC ID : TSF107020
Client : Nera SatCom AS

Tested according to :

FCC part 15, subpart C
Frequency Hopping Transmitters

RSS-210, Issue 6
Low Power Licence-Exempt Radiocommunication Devices

Date of issue : 28 November 2005

Authorised by :

Gunn Røym
Laboratory Manager

CONTENTS

1	GENERAL INFORMATION.....	3
1.1	Testhouse Info	3
1.2	Client Information.....	3
1.3	Manufacturer.....	3
2	Test Information	4
2.1	Tested Item	4
2.2	Test Environment.....	4
2.3	Test Period.....	4
3	TEST REPORT SUMMARY.....	5
3.1	General	5
3.2	Test Summary.....	6
3.3	Description of modification for Modification Filing	6
3.4	Comments.....	6
3.5	Family List Rational.....	6
4	TEST RESULTS.....	7
4.1	Powerline Conducted Emissions	7
4.2	Channel Separation	10
4.3	Pseudorandom Hopping Algorithm.....	12
4.4	Occupancy Time	13
4.5	Occupied Bandwidth	15
4.6	Peak Power Output.....	17
4.7	Spurious Emissions (Radiated)	21
5	LIST OF TEST EQUIPMENT	35
6	BLOCK DIAGRAM	36
6.1	Powerline Conducted Emission	36
6.2	Peak Power Output.....	37
6.3	Test Site Radiated Emission.....	37

1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko Comlab AS
Address : Gåsevikveien 8, Box 96
N-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: post@comlab.no
Managing Director: Jon Ivar Tidemann
FCC test firm registration # : 994405
IC OATS registration # : 4443

1.2 Client Information

Name : Nera SatCom AS
Address : Bergerveien 12, N-1375 Billingstad, Norway
Telephone : +47 67 24 47 00
Fax : +47 67 24 44 45

Contact:

Name : Roy Uggerud

1.3 Manufacturer

Name : Nera SatCom AS
Address : Bergerveien 12, N-1375 Billingstad, Norway
Telephone : +47 67 24 47 00
Fax : +47 67 24 44 45

2 Test Information

2.1 Tested Item

Name :	WorldPro 1000 Bluetooth Module
FCC ID :	TSF107020
Industry Canada ID :	6200A-107020
Model/version :	BGAN
Serial number :	0305080036
Hardware identity and/or version:	107020
Software identity and/or version :	/
Frequency Range :	2402 - 2480 MHz
Tunable Bands :	1
Number of Channels :	79
Modulation :	GFSK
Emissions Designator :	1MF1D
User Frequency Adjustment :	None, Software controlled.
Rated Output Power :	1 mW

Theory of Operation

The tested equipment is a Bluetooth device that is integrated into a satellite terminal. The bluetooth device is used to connect a cordless telephone handset to the satellite terminal.

The tested equipment has integral antennas only.

2.2 Test Environment

2.2.1 Normal test condition

Temperature: 20 - 23 °C

Relative humidity: 30 - 40 %

Normal test voltage: 115 V AC

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2005-11-02

Test period : from 2005-11-02 to 2005-11-03

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: Nera Satcom

Model No.: BGAN

Serial No.: /

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC Part 15, Subpart C, paragraph 15.247 for Frequency Hopping Spread Spectrum devices and Industry Canada RSS-210 Frequency Hopping Spread Spectrum.

Radiated tests were conducted in accordance with ANSI C63.4-2001. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 metres.

☒ New Submission

☒ Production Unit

☐ Class II Permissive Change

☐ Pre-production Unit

DSS Equipment Code

☐ Family Listing

THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in "Summary of Test Data".



NEMKO COMLAB REF: 52320-10

TESTED BY:

Frode Sveinsen, Test engineer

DATE: 16 November 2005

The results detailed in this test report are valid only for the particular sample(s) tested and with configuration(s) as implemented during testing. This test report can only be reproduced or published in full. Reproduction or publishing of parts of this test report requires the prior written approval of Nemko Comlab.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Comlab AS accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report.

3.2 Test Summary

Name of test	FCC Part 15 reference	RSS-210 reference	Result
Powerline Conducted Emission	15.207(a)	RSS-GEN, 7.2	Complies
Channel Separation	15.247(a)(1)	Annex 8.1	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	Annex 8.1	Complies
Time of Occupancy	15.247(a)(1)(iii)	Annex 8.1	Complies
Occupied Bandwidth	15.247(a)(1)	Annex 8.1	Complies
Peak Power Output	15.247(b)	Annex 8.4	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	Annex 8.5	Complies
Spurious Emissions (Radiated)	15.247(c)	Annex 8.5	Complies

3.3 Description of modification for Modification Filing

Not Applicable.

3.4 Comments

This test report covers only the Bluetooth Module integrated into the Nera Satcom WorldPro 1000.

The channels and antenna to operate on was selected from a computer connected to the satellite telephone. The computer was used only for selection of channel and antenna and was removed during the measurements.

The measurements were done with the EUT powered by 115 V AC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during spurious emission measurements.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

4.1 Powerline Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: Geir Antonsen

Date of Test: 22 November 2005

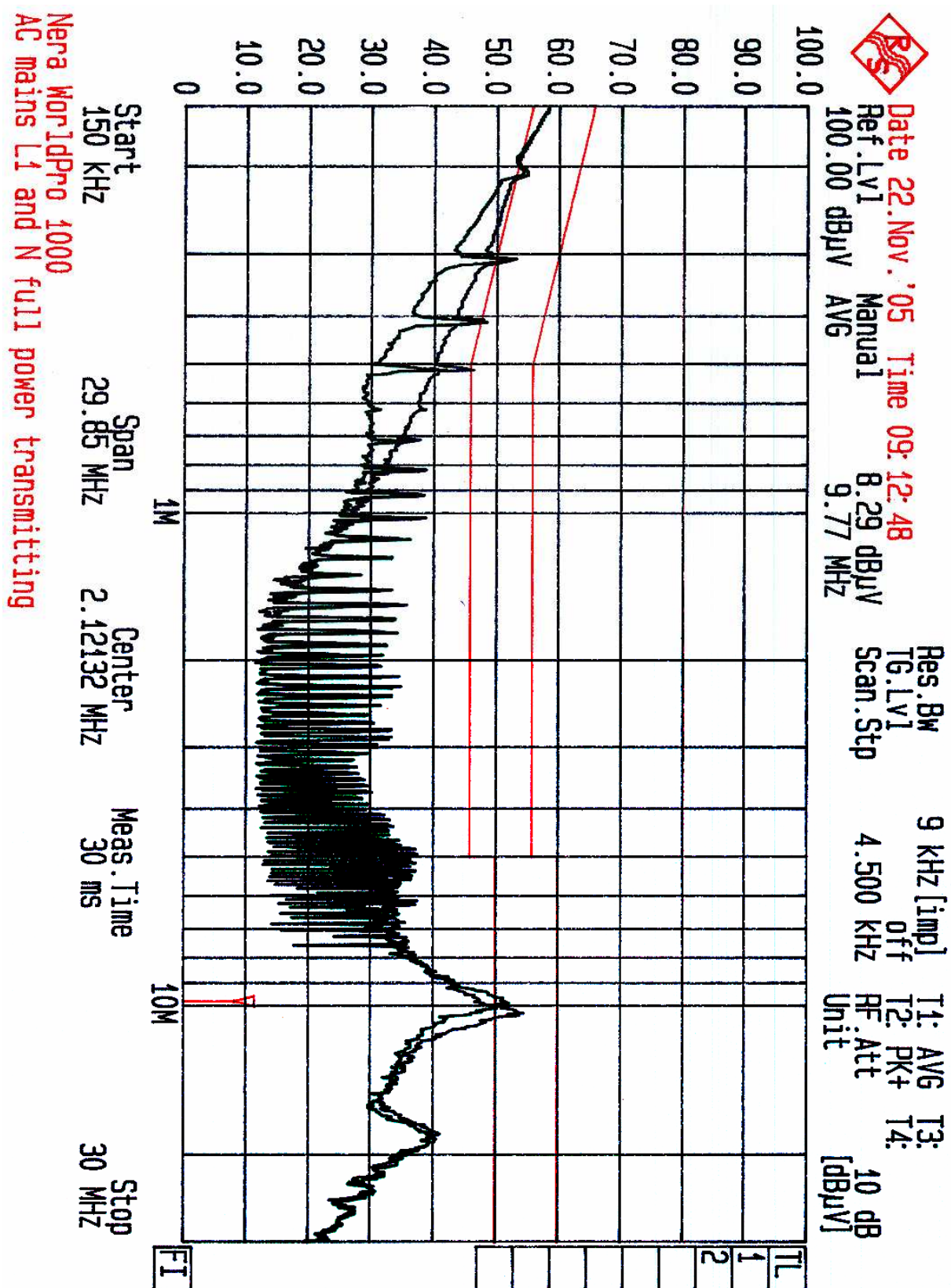
Measurement procedure: CISPR 22 1997 Clause 5.1 Class B ITE using 50 μ H/50 ohms LISN.

Test Results: **Complies.**

Measurement Data: **See attached graph, (Peak detector).**

Highest measured value (L1 and N):

Frequency	Detector	Measured value	Limit	Margin
KHz	QP/AV	dB μ V	dB μ V	dB
150	QP	53	66	13
	AV	21	56	35
307	QP	49	60	11
	AV	43	50	7
9800	QP	41	60	9
	AV	40	50	10



AC Mains, Transmitting at Full Power, L1 and N, Peak Detector

Nera WorldPro 1000
AC mains Charging

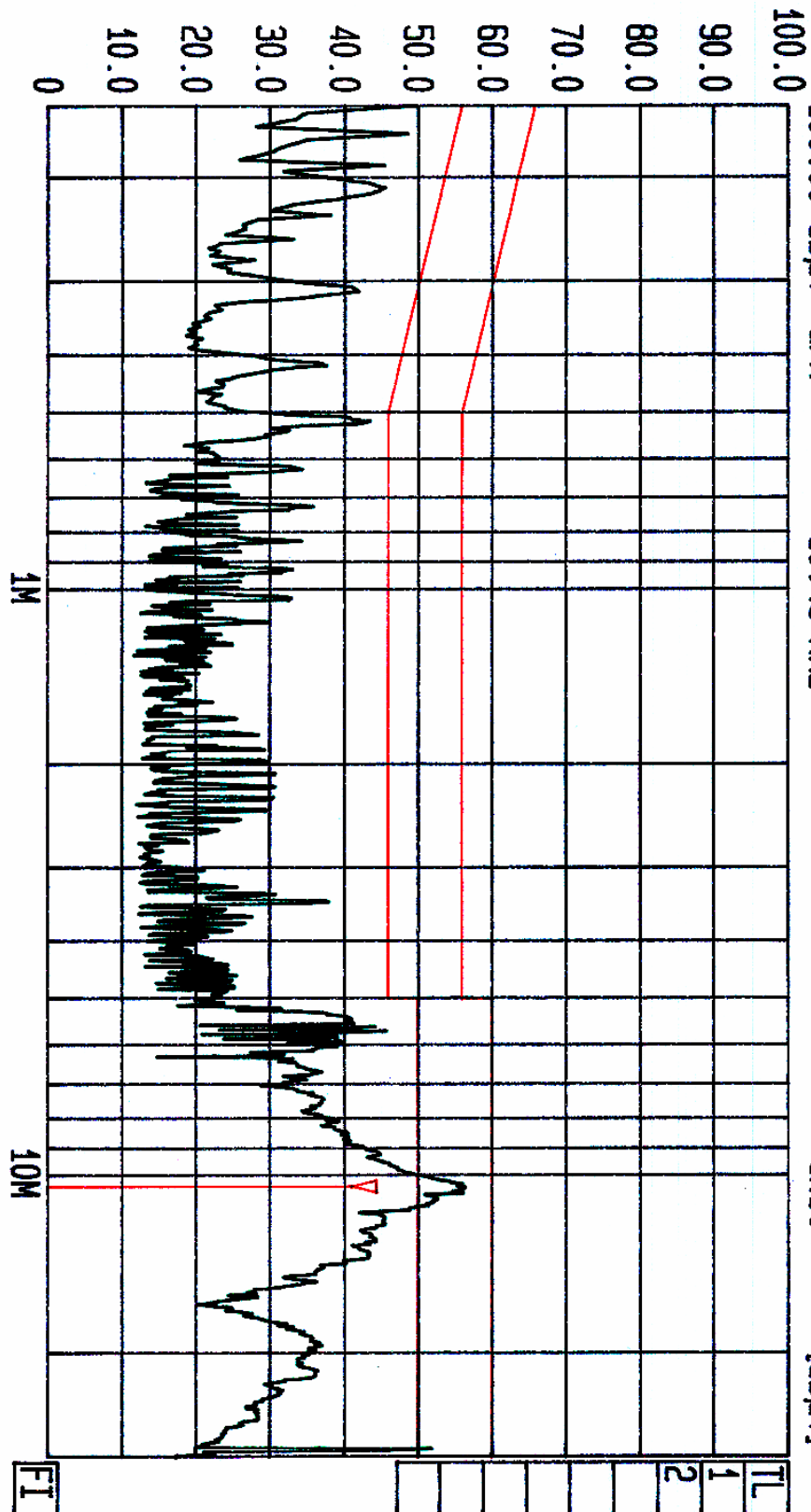
Start
150 kHz

Span
29.85 MHz

Center
2.12132 MHz

Meas. Time
30 ms

Stop
30 MHz



Date 22.Nov.'05 Time 08:43:22
Ref.Lvl 100.00 dBμV Manual
DPK 41.20 dBμV
10.45 MHz

Res.Bw 9 kHz [imp]
T6.Lvl
Scan.Stp 4.500 kHz

T1: PK+ T3:
T2: RF: Att T4:
Unit [dBμV]

AC Mains, Charging, Peak Detector

4.2 Channel Separation

Para. No.: 15.247 (a)(1)

Test Performed By: Frode Sveinsen

Date of Test: 3 November 2005

Test Results: **Complies**

Measurement Data: Channel Separation: $4.018/4 = 1.005$ MHz
20 dB Bandwidth of hopping channel: 1.052 MHz

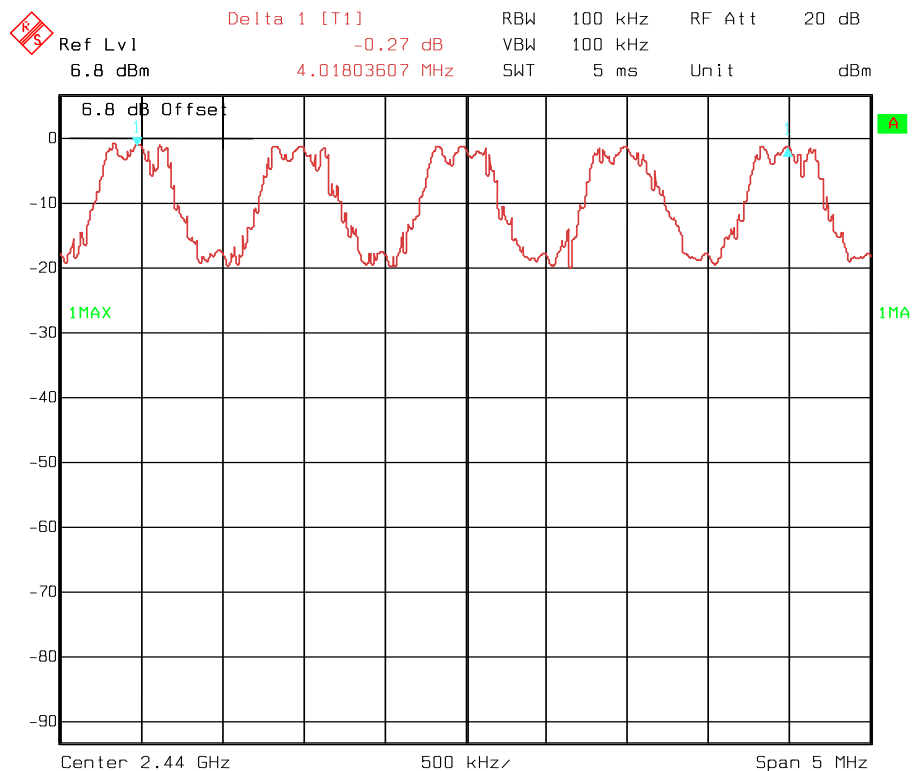
RF channel (0 to 78) has no influence on 20 dB bandwidth.

See attached graph

Channel Separation nominal value: 1.728 MHz.

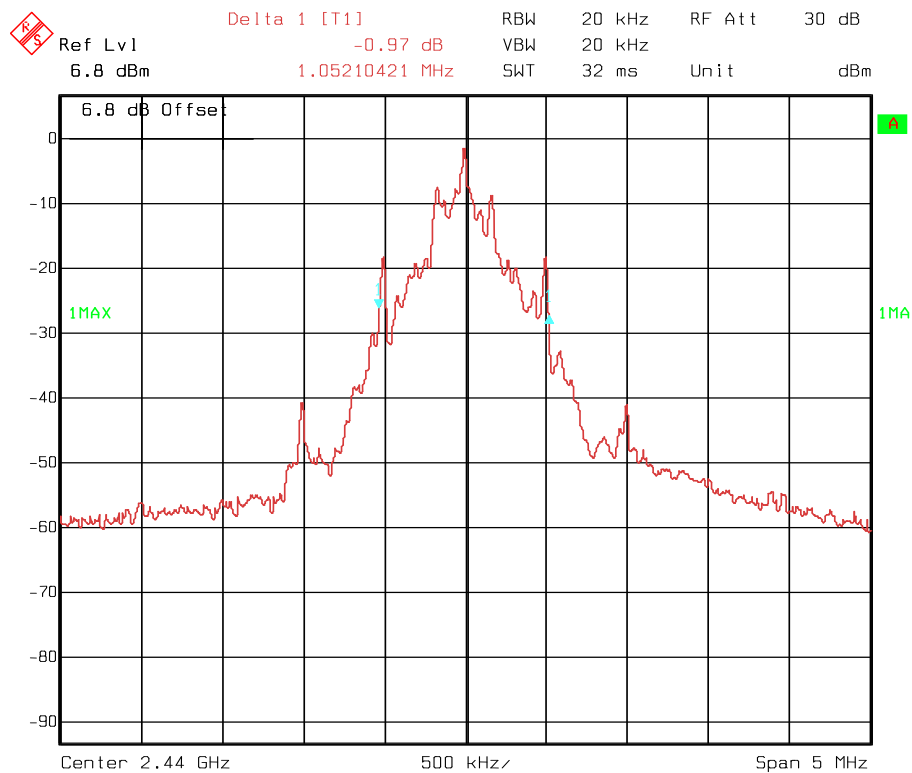
Requirement:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the system operates with an output power no greater than 125 mW.



Date: 3.NOV.2005 13:35:26

Channel separation



Date: 3.NOV.2005 13:05:57

20 dB Bandwidth

4.3 Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Performed By: Frode Sveinsen	Date of Test: 3 November 2005
-----------------------------------	-------------------------------

Test Results: Complies

Measurement Data: /

Requirements:

The channel frequencies shall be selected from a pseudorandom ordered list of hopping frequencies. Each frequency must be used equally by the transmitter.

Base Table Hopping Sequence

All 79 frequencies are used in a random order in each hop sequence. The hop sequence is repeated every 99 seconds. The hopping sequence follows the Bluetooth standard.

4.4 Occupancy Time

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Frode Sveinsen	Date of Test: 3 November 2005
-----------------------------------	-------------------------------

Test Results: Complies

Measurement Data:

Number of RF channel: 79

RF burst pr channel: 415µs

Average time between each RF burst on same RF channel: $79 * 1250 \mu s = 98.75 \text{ ms}$

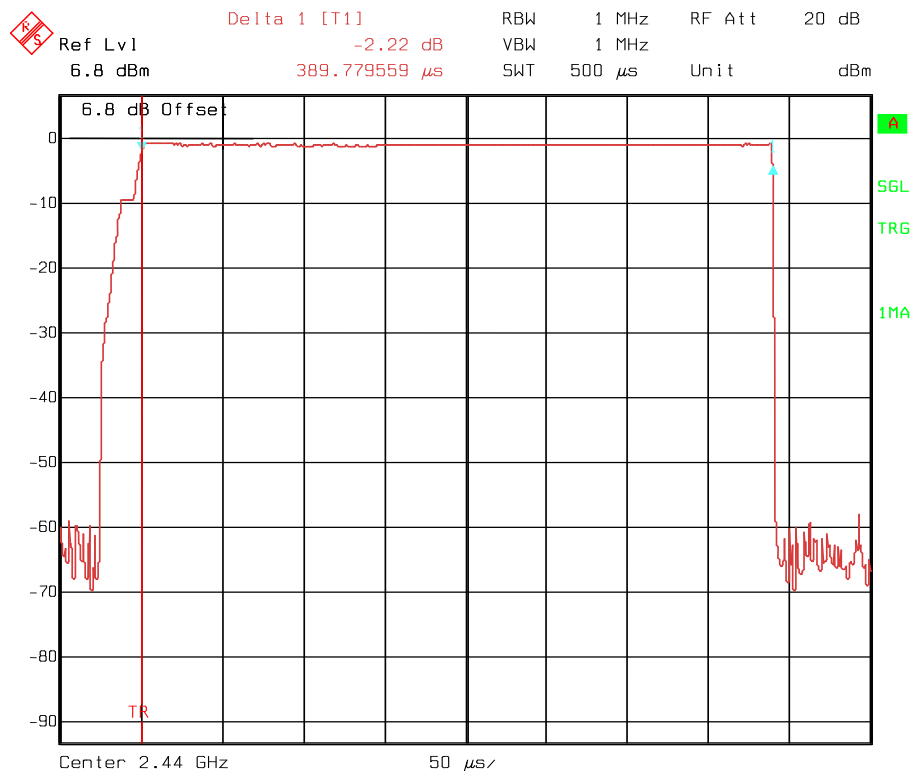
Average time of occupancy:

$(0.42 \text{ ms} / 98.75 \text{ ms}) * 0.4 \text{ s} * 79 = 134 \text{ ms}$

See attached graph.

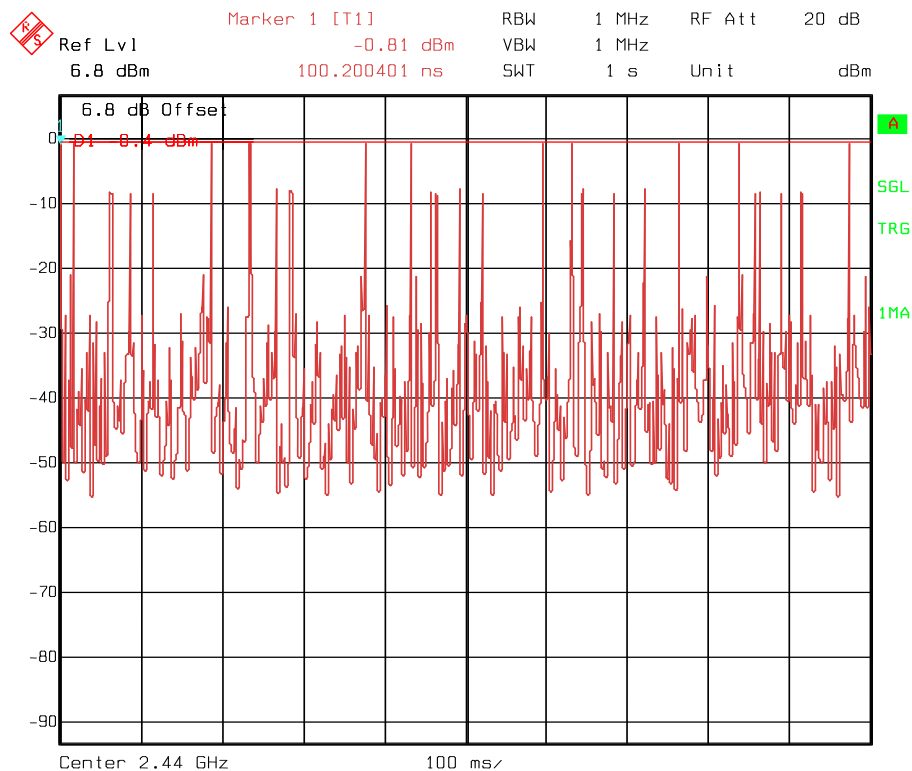
Requirements:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Date: 3.NOV.2005 13:40:47

RF burst



Date: 3.NOV.2005 13:56:31

Occupancy time pr. channel

4.5 Occupied Bandwidth

Para. No.: 15.247 (a)(1)(iii)

Test Performed By: Frode Sveinsen
--

Date of Test: 3 November 2005

Test Results: Complies

Measurement Data: 79 RF channels in use

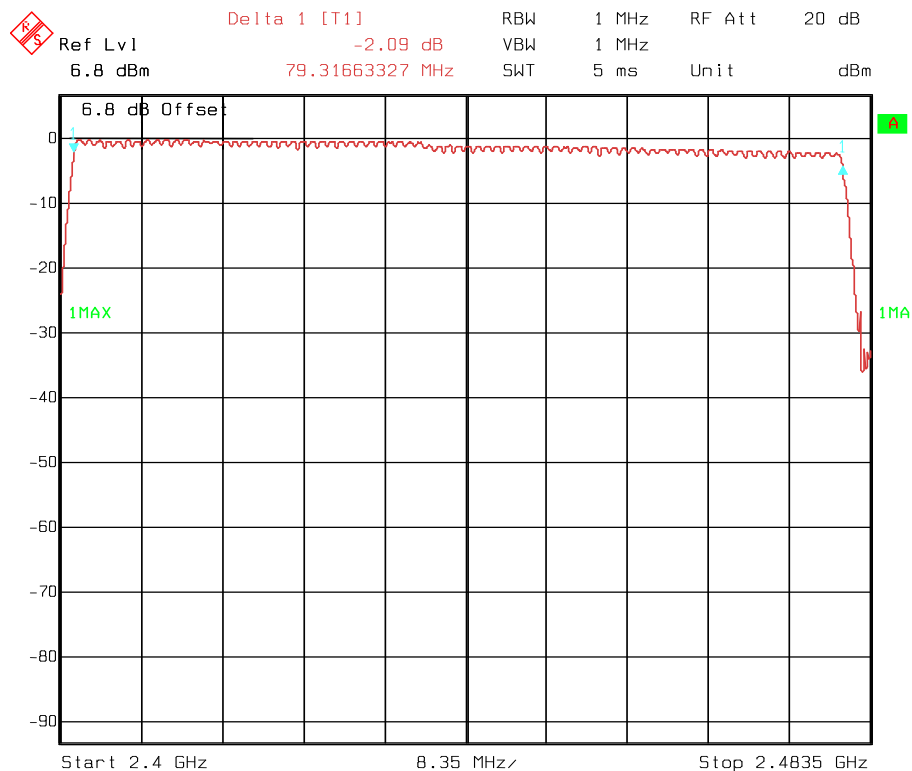
See attached graph.

Requirements:

Frequency hopping systems in the 2400 - 2483.5 MHz band shall use at least 15 non-overlapping channels. No requirements for bandwidth for this frequency band.

Channel Centre Frequencies

The 79 channels are centred at each full MHz from 2402 to 2480 MHz.



Date: 3.NOV.2005 13:28:54

RF channel in use

4.6 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: Frode Sveinsen

Date of Test: 2-3 November 2005

Test Results: Complies

Measurement Data:

Maximum Conducted Peak Output Power, Watts

RF channel	0	38	78
Measured value	0.000966	0.000804	0.000604

Maximum EIRP, Watts

RF channel	0	38	78
Measured EIRP	0.000106	0.000109	0.000079
Antenna gain dBi	-9.6	-8.7	-8.8

Antenna gain = $10 \cdot \log(\text{EIRP} / \text{Conducted power})$ dBi

The EIRP is calculated from measured field strength by the formula:

$$P = (E \cdot d)^2 / 30 \quad (\text{the formula in DA00-705 with antenna gain 0 dBi})$$

See attached graph.

Detachable antenna?

☐ Yes ☒ No

If detachable, is the antenna connector non-standard?

☐ Yes ☐ No

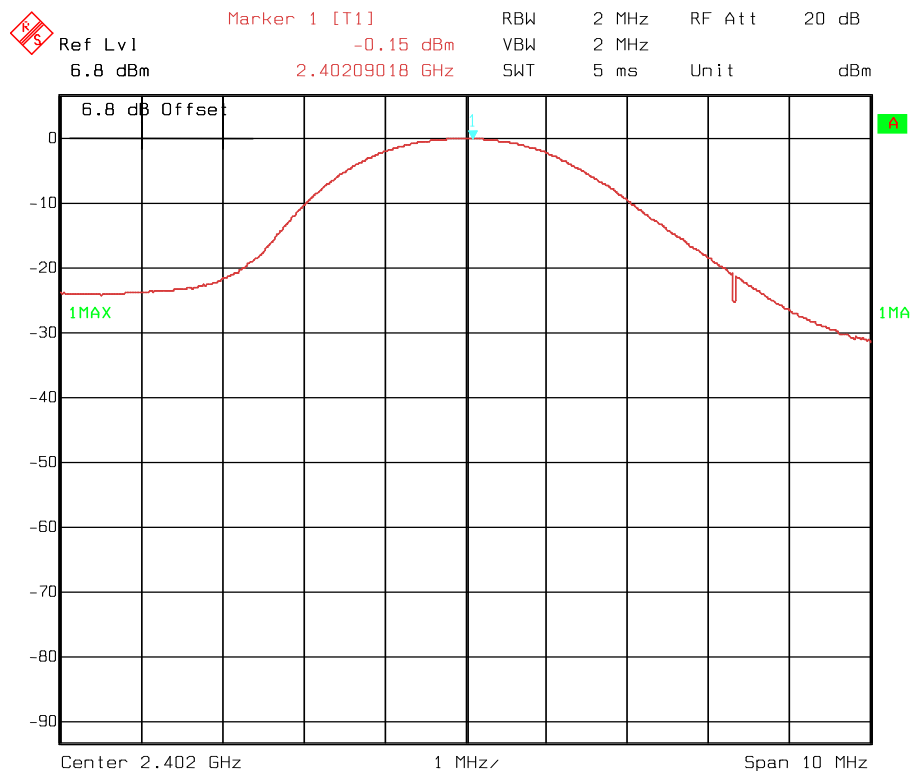
Requirements:

The maximum peak output power for frequency hopping systems shall not exceed the following limits:

For systems employing at least 75 hopping channels: 1 watt

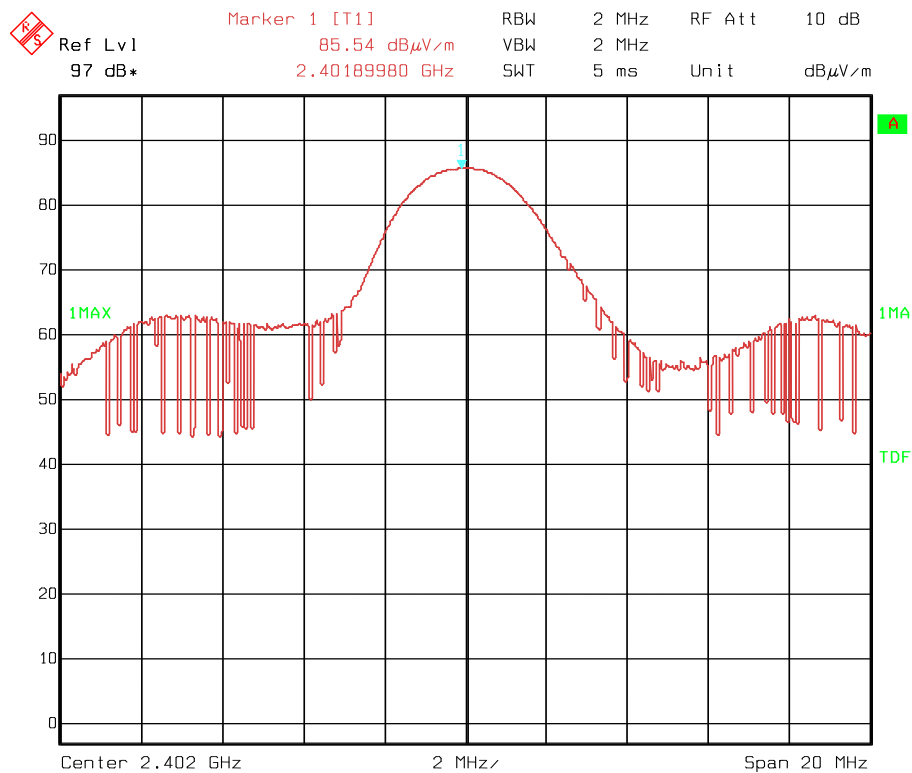
For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 watts

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



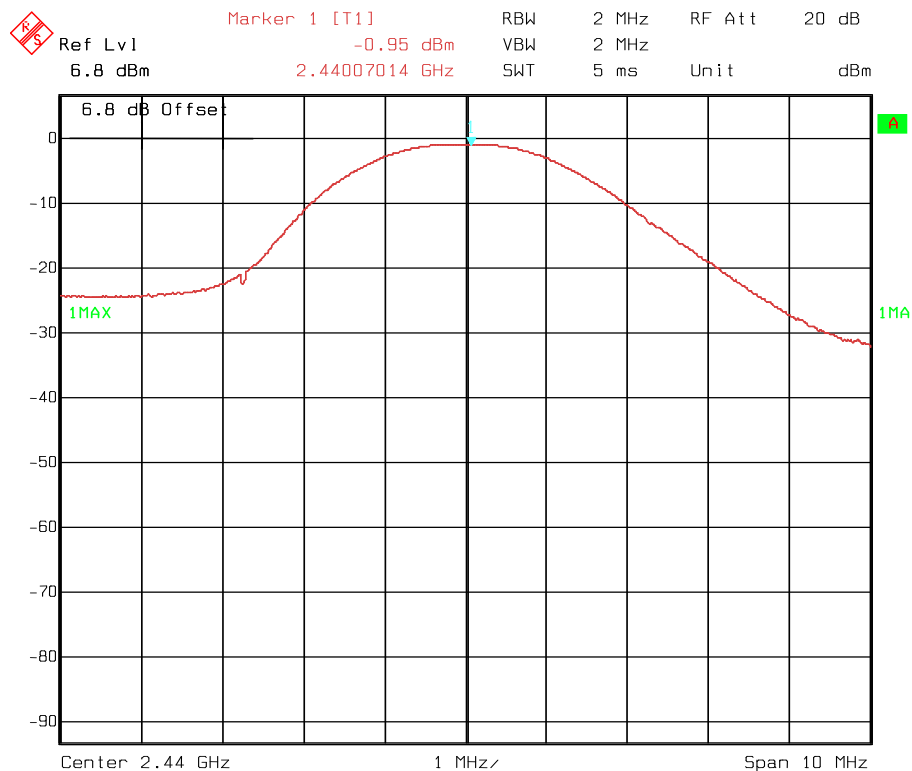
Date: 3.NOV.2005 13:12:44

RF conducted channel 0



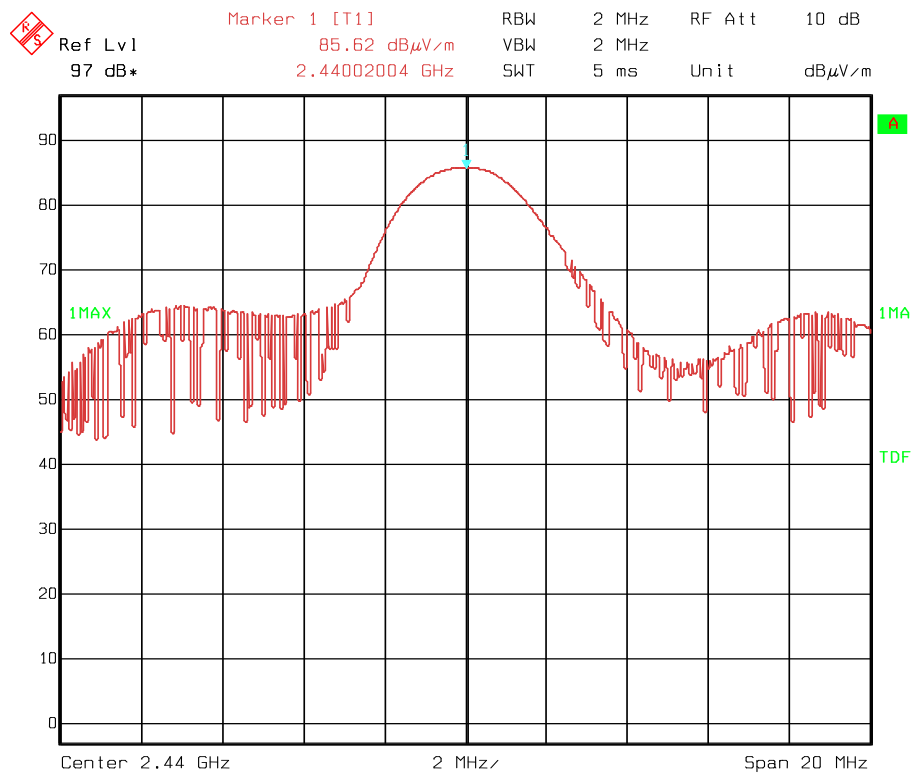
Date: 2.NOV.2005 10:45:22

RF radiated channel 0



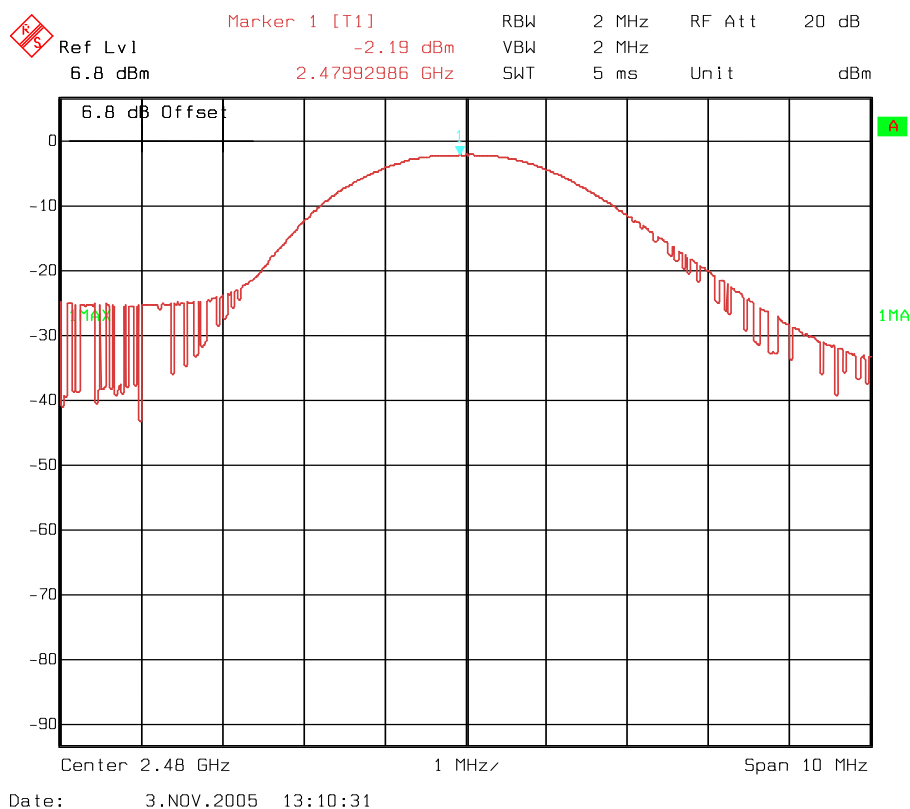
Date: 3.NOV.2005 13:11:38

RF conducted channel 38

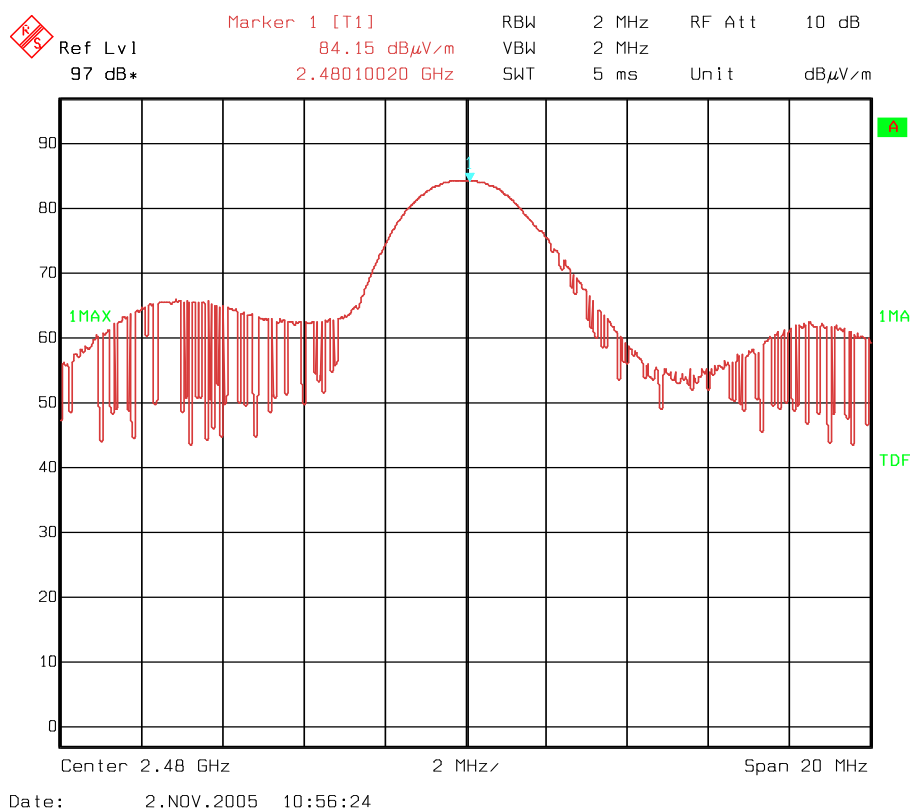


Date: 2.NOV.2005 11:22:27

RF radiated channel 38



RF conducted channel 78



RF radiated channel 78

4.7 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: Frode Sveinsen

Date of Test: 2 November 2005

Test Results: Complies

Measurement Data:

Band-edge radiated power

Measured on ch 0 and 78

Frequency GHz	Power below nearest channel dBμV/m		Limit dBμV/m		Margin dB	
	Peak	Average	Peak	Average	Peak	Average
2.39	51	31	74	54	23	23
2.4835	59	39	74	54	15	15

The average value is calculated from the Peak value by using the Duty-Cycle correction factor.

See attached plots.

Duty Cycle Calculation:

See also Para 4.4 Occupancy Time.

RF duty cycle: Calculation according to RF burst Para 15.35 (c)

$$20 \cdot \log(0.42 \text{ ms} / 98.75 \text{ ms}) = -47.4 \text{ dB}$$

Maximum Duty-Cycle Correction factor according to Para 15.35 (b): **-20 dB**

This value is used when measuring average field strength above 1 GHz with Peak Detector function employed on spectrum analyzer.

RF conducted power to 25 GHz

Maximum RF level outside operating band:

RF ch 0: <-50 dB/C, margin >30 dB

RF ch 23: <-50 dB/C, margin >30 dB

RF ch 46: <-50 dB/C, margin >30 dB

See attached plots.

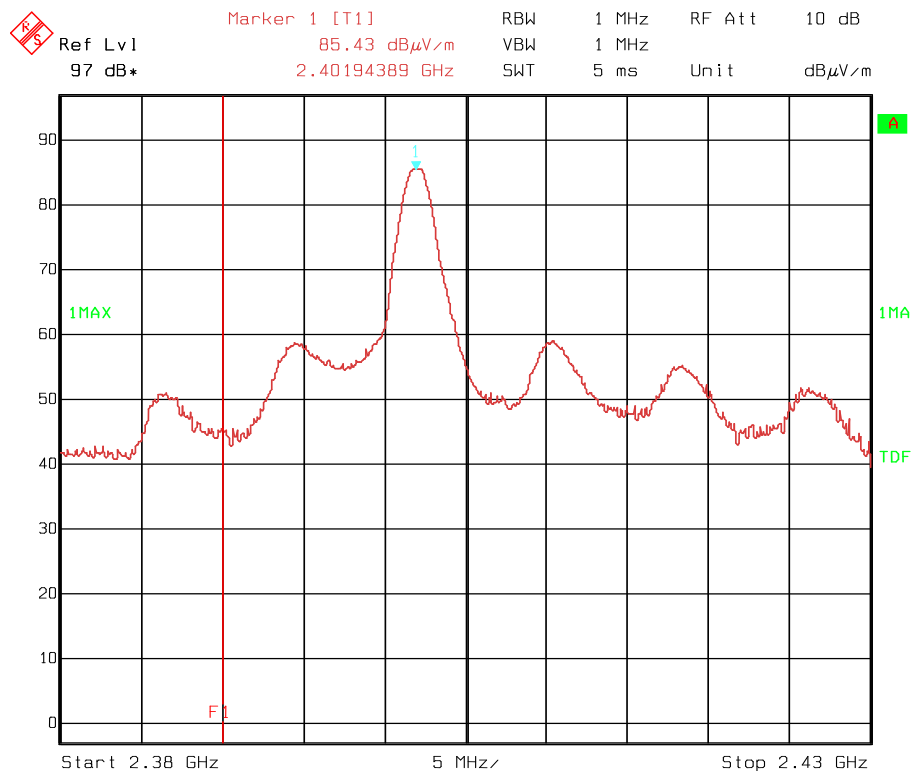
Radiated Emissions, 1-25 GHz

1-18 GHz measured at a distance of 3m, 18-25 GHz measured at 1m.

No spurious emissions were detected in any of the restricted bands.

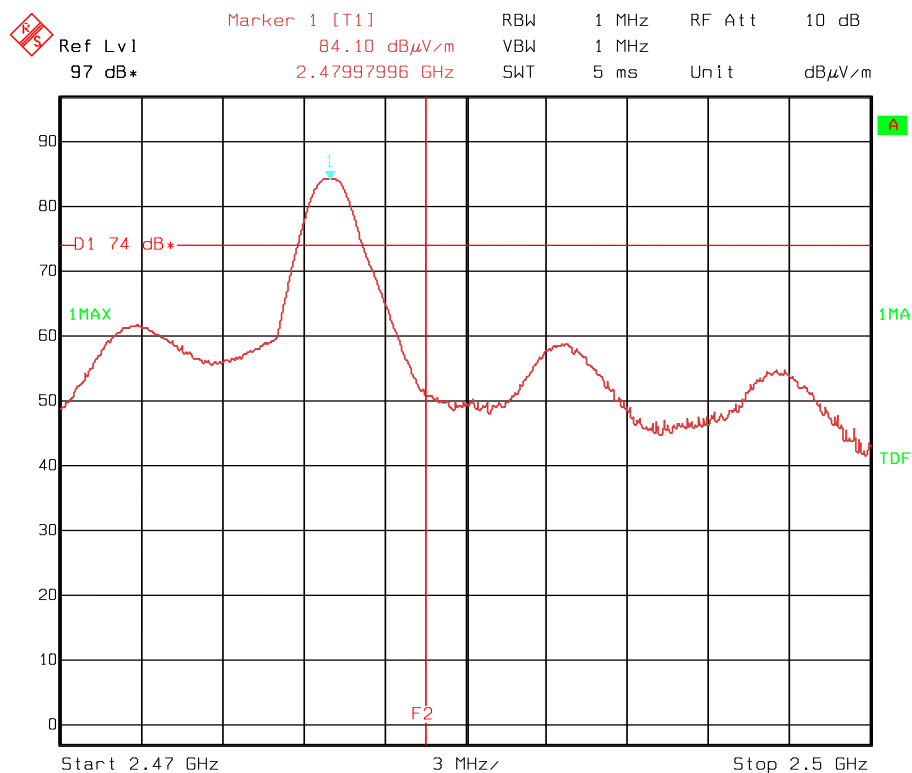
See attached graphs.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".



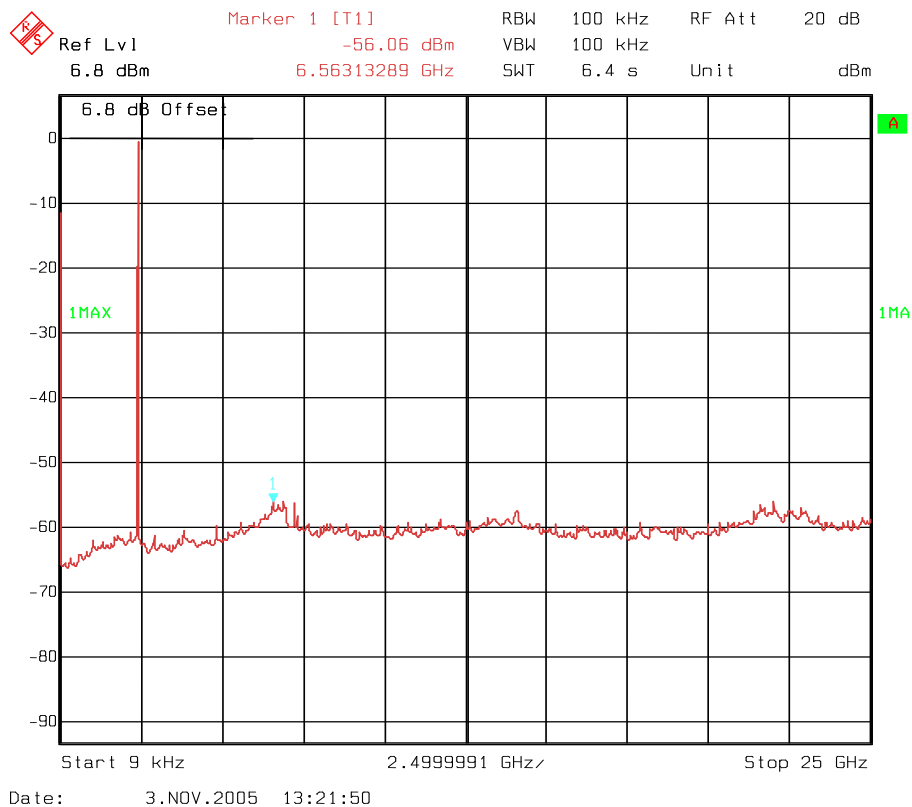
Date: 2.NOV.2005 10:47:37

Band-edge radiated power ch 0, lower end.

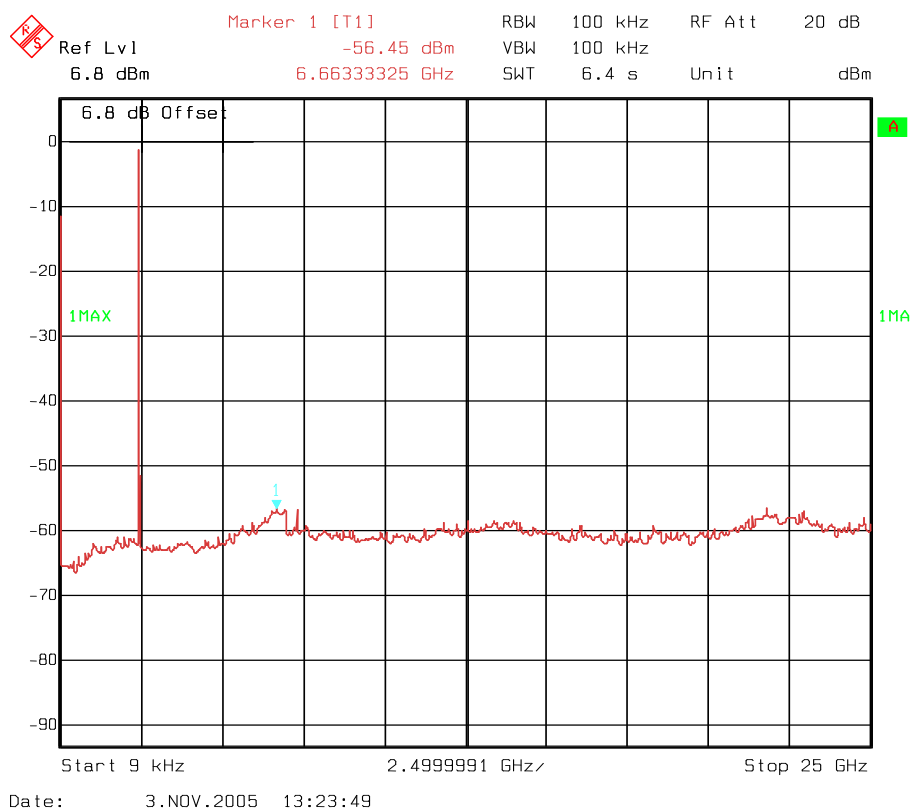


Date: 2.NOV.2005 10:55:14

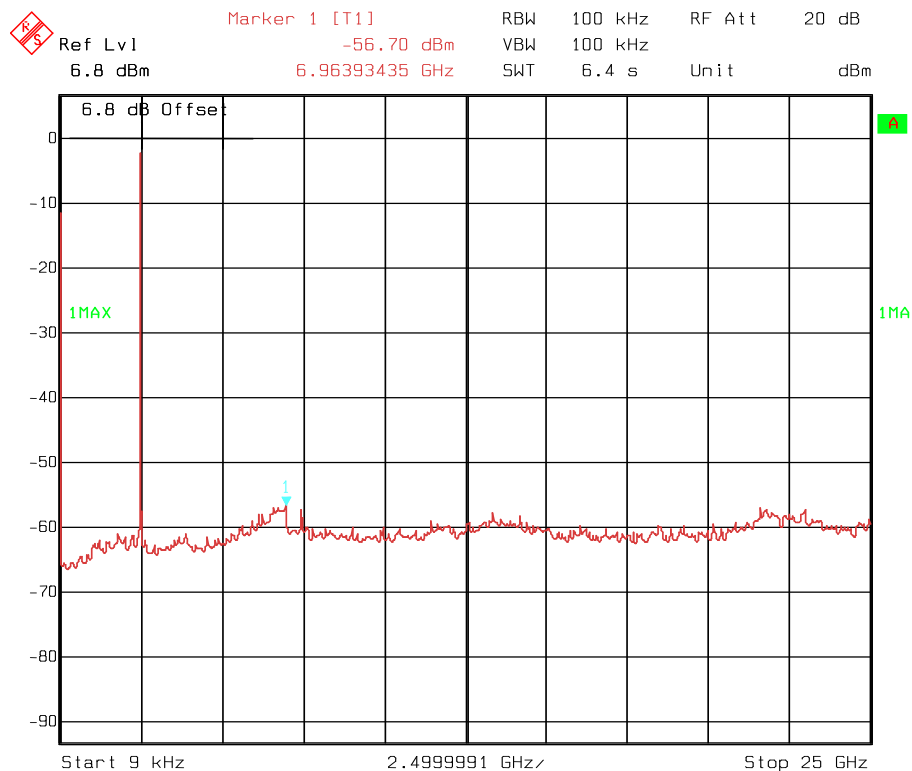
Band-edge radiated power ch 78, upper end.



RF conducted emissions, ch 0

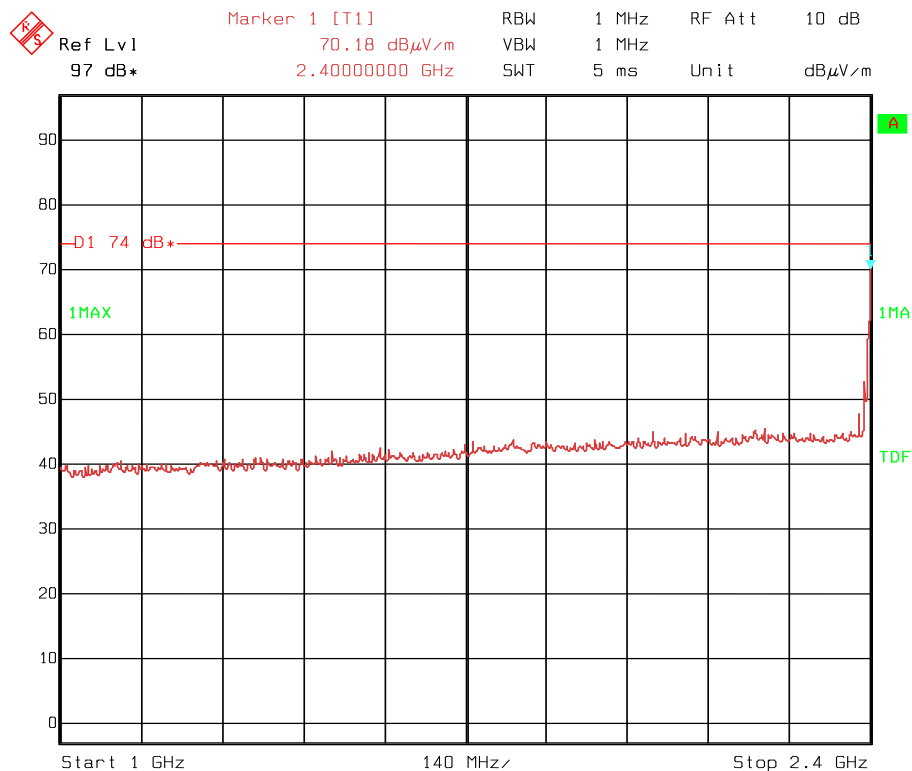


Rf conducted emissions, ch 38



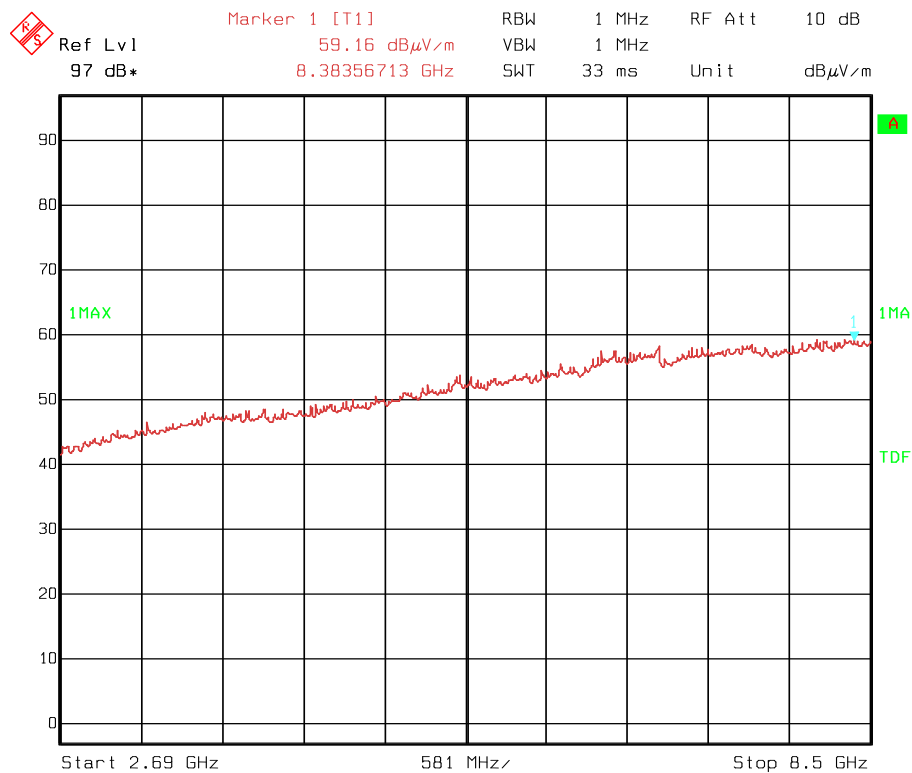
Date: 3.NOV.2005 13:24:50

RF conducted emissions ch 78



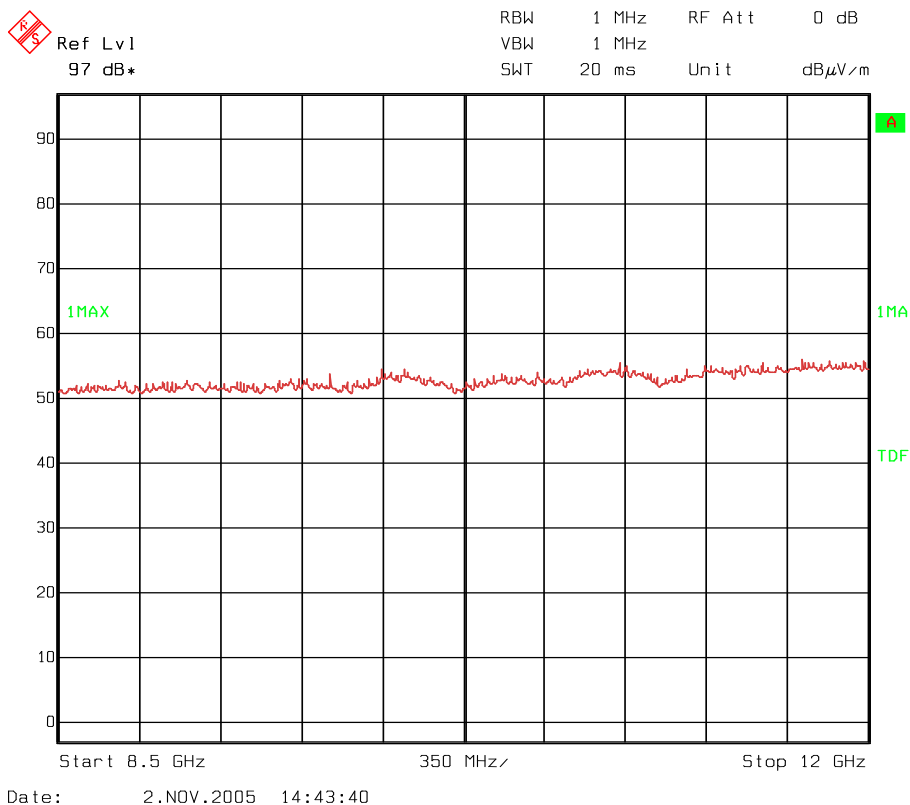
Date: 2.NOV.2005 10:34:16

RF radiated emissions 1-2.4 GHz channel 0

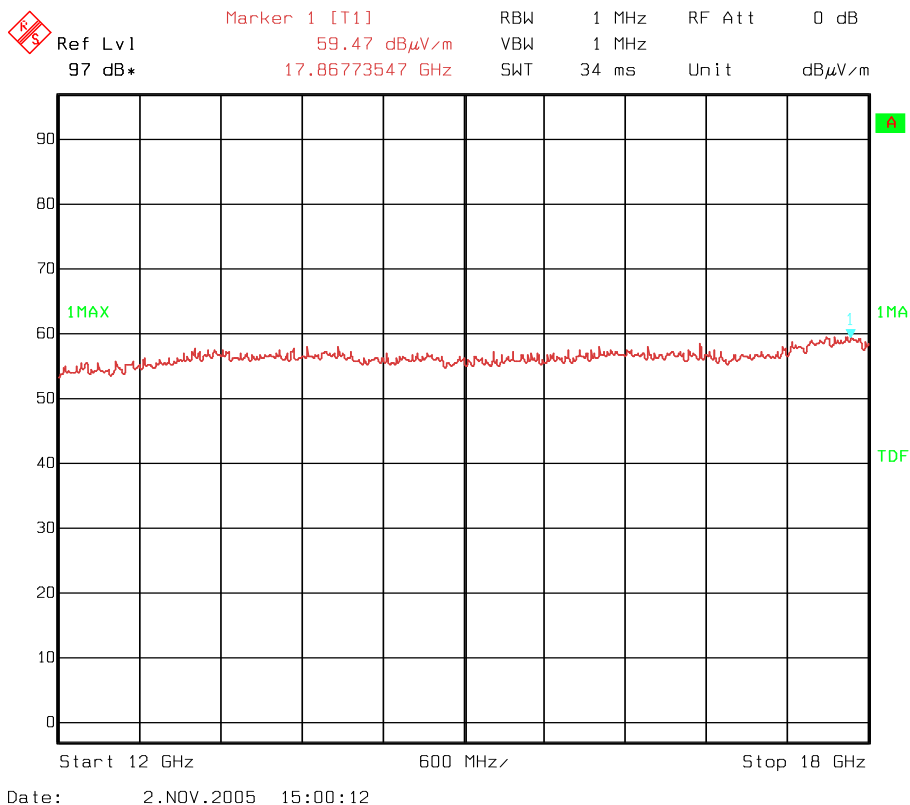


Date: 2.NOV.2005 11:19:26

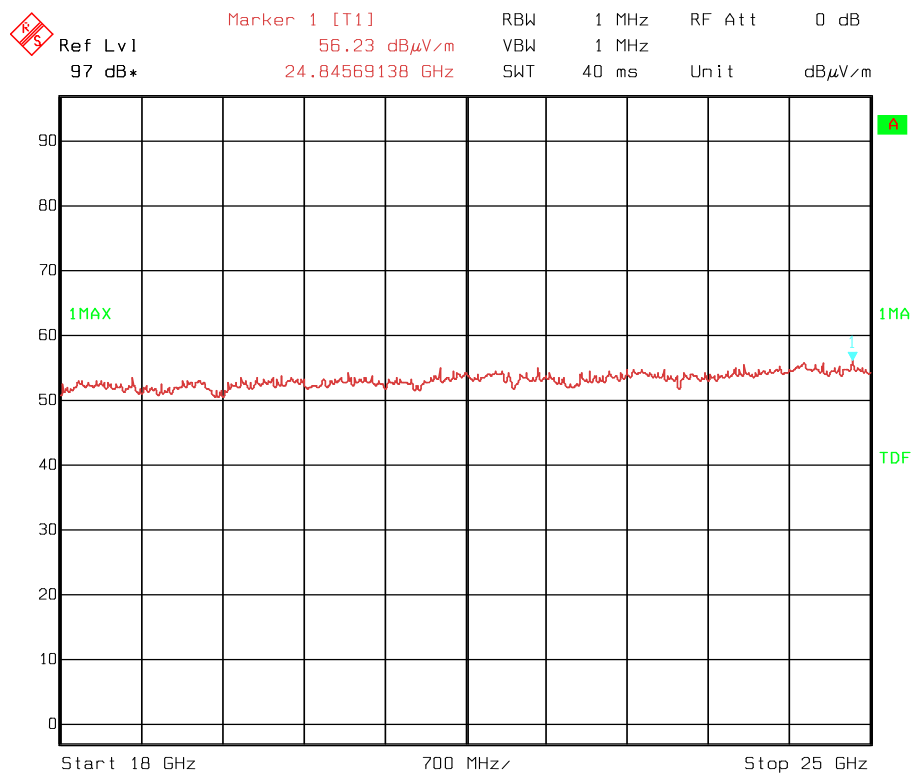
RF radiated emissions 2.69-8.5 GHz channel 78



RF radiated emissions 8.5-12 GHz channel 0



RF radiated emissions 12-18 GHz channel 0



Date: 2.NOV.2005 15:24:51

RF radiated emissions 18-25 GHz channel 0

Radiated emission 30 – 1000 MHz.

Detector: Quasi-Peak

Measuring distance 10 m according to CISPR 22.

Tested in speech mode with active connection.

Frequency	Operational condition	Field strength	Measuring distance	Limit FCC15.209	Margin
MHz		dB μ V/m	metres	dB μ V/m	dB
46.794	TX on	26.0	3	40	14.0
149.29	TX on	22.4	3	40	17.6
388.11	TX on	32.5	3	40	7.5

See attached graphs.

Radiated emission 10 kHz-30 MHz.

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).

NEMKO COMLAB AS

02. Nov 05 13:19

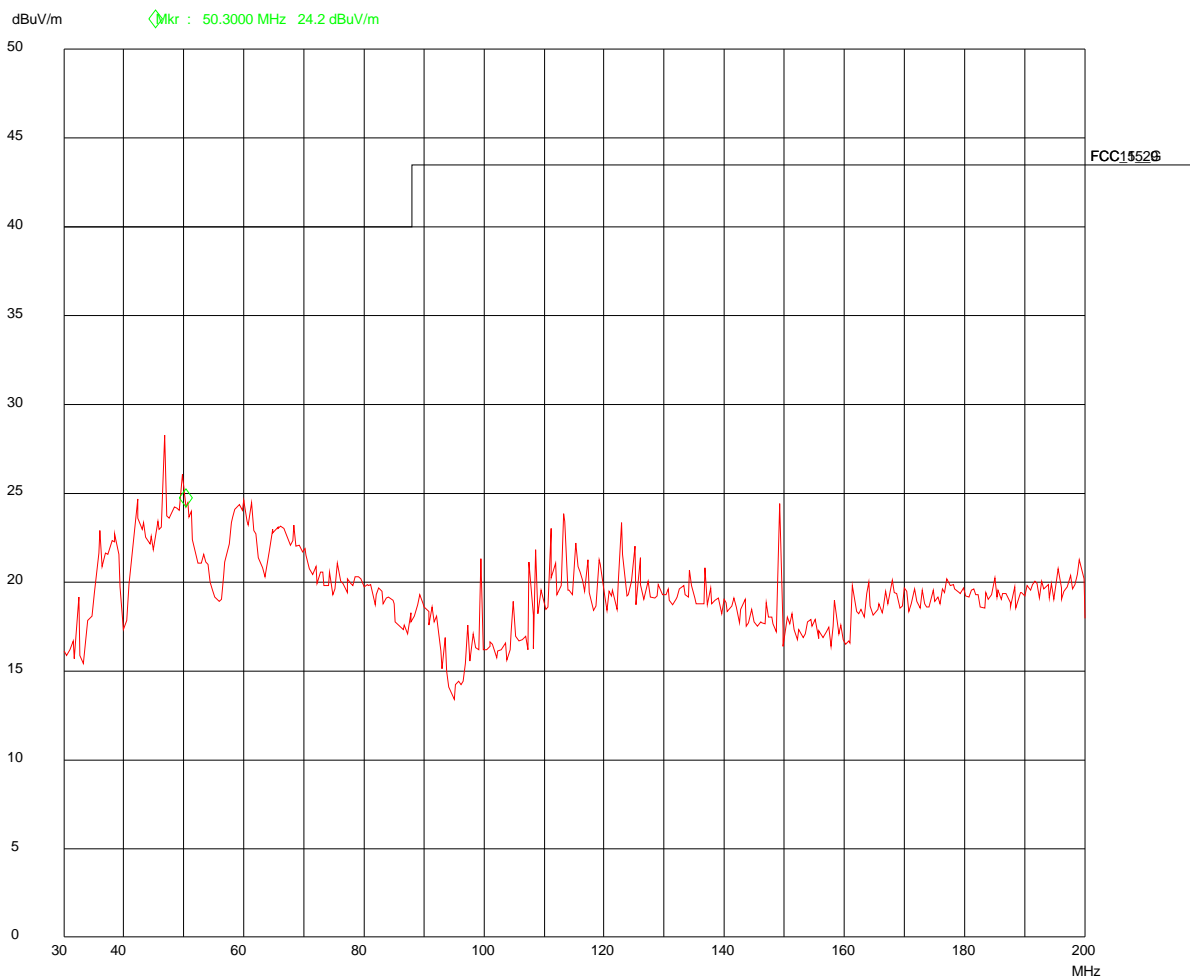
Peak

Operator: EH
Comment: Nera Satcom AS
WorldPro 1000
FCC 15209
VP 1m
Distance 3 m

Scan Settings (1 Range)

Frequencies				Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp OpRge
30M	200M	50k	120k	PK	50ms	AUTO	LN ON 60dB

Transducer No.	Start	Stop	Name
20	30M	200M	HK116



30-200 MHz vertical polarized, measuring distance 3 m

NEMKO COMLAB AS

02. Nov 05 13:27

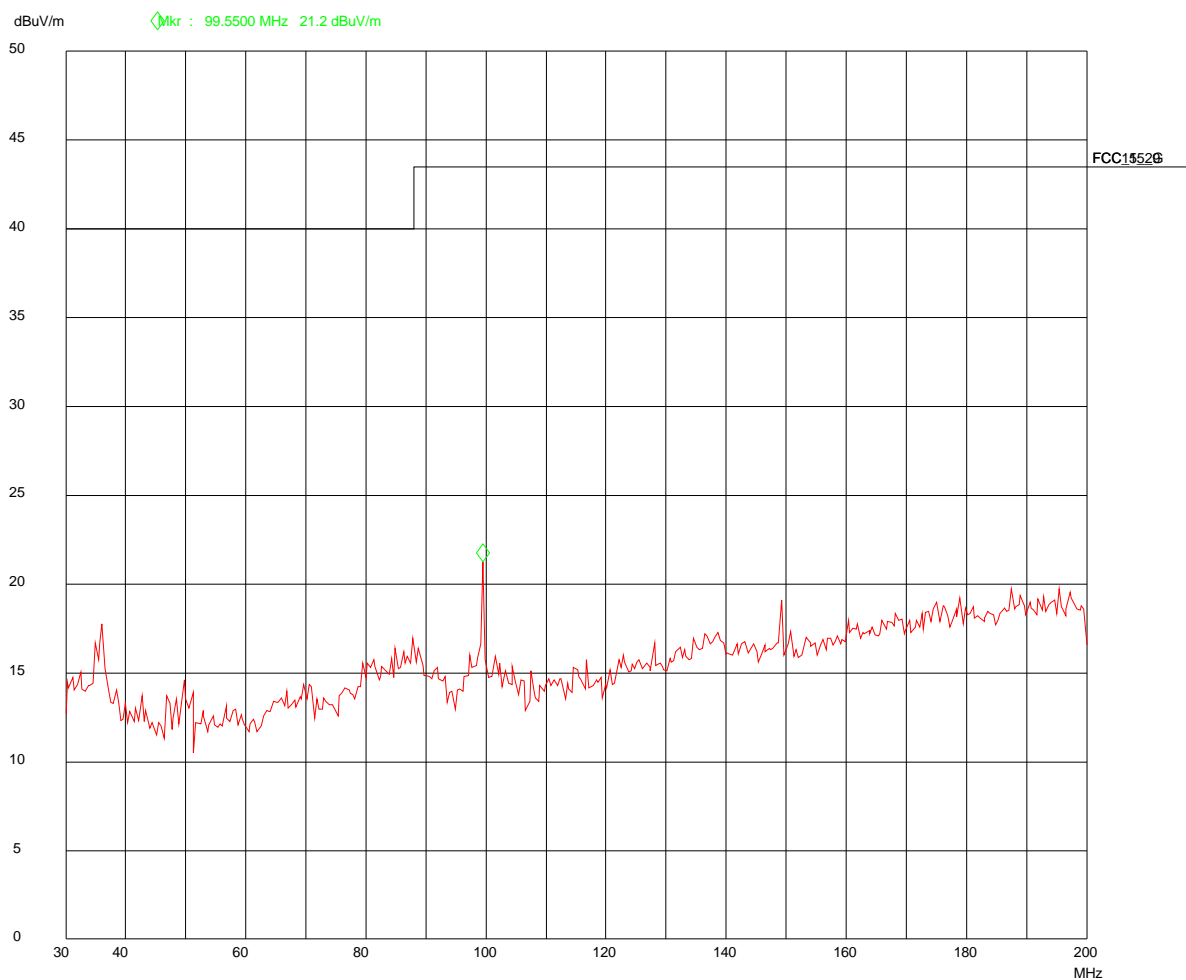
Peak

Operator: EH
Comment: Nera Satcom AS
WorldPro 1000
FCC 15209
HP 2m
Distance 3 m

Scan Settings (1 Range)

Frequencies				Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp OpRge
30M	200M	50k	120k	PK	50ms	AUTO	LN ON 60dB

Transducer No.	Start	Stop	Name
20	30M	200M	HK116



30-200 MHz, horizontal polarization, measuring distance 3 m

NEMKO COMLAB AS

02. Nov 05 13:50

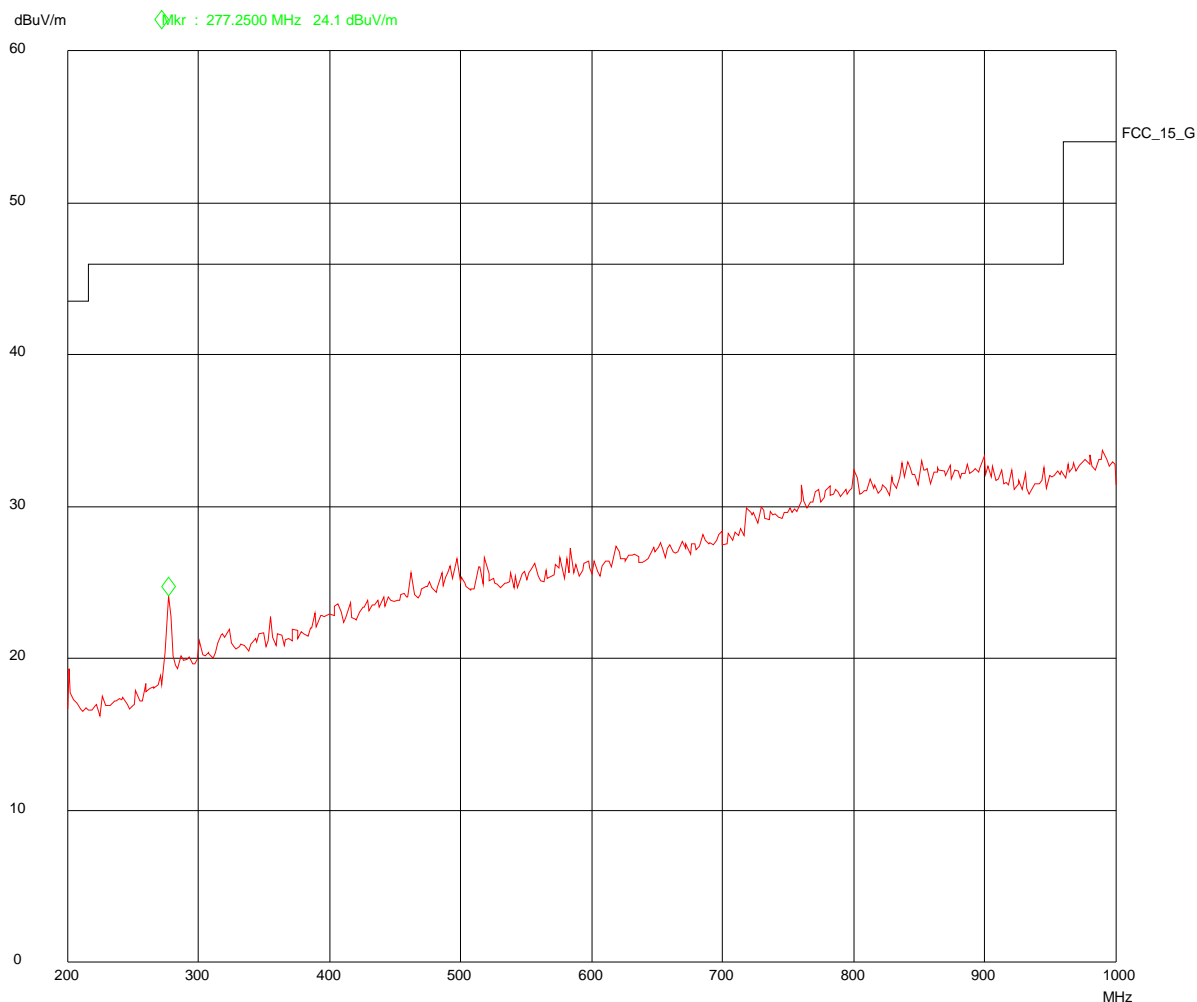
Peak

Operator: EH
Comment: Nera Satcom AS
WorldPro 1000
FCC 15209
VP 1m
Distance 3 m

Scan Settings (1 Range)

----- Frequencies -----||----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB

Transducer No. Start Stop Name
21 200M 1000M HL223



200-1000 MHz, vertical polarization, measuring distance 3 m

NEMKO COMLAB AS

02. Nov 05 14:06

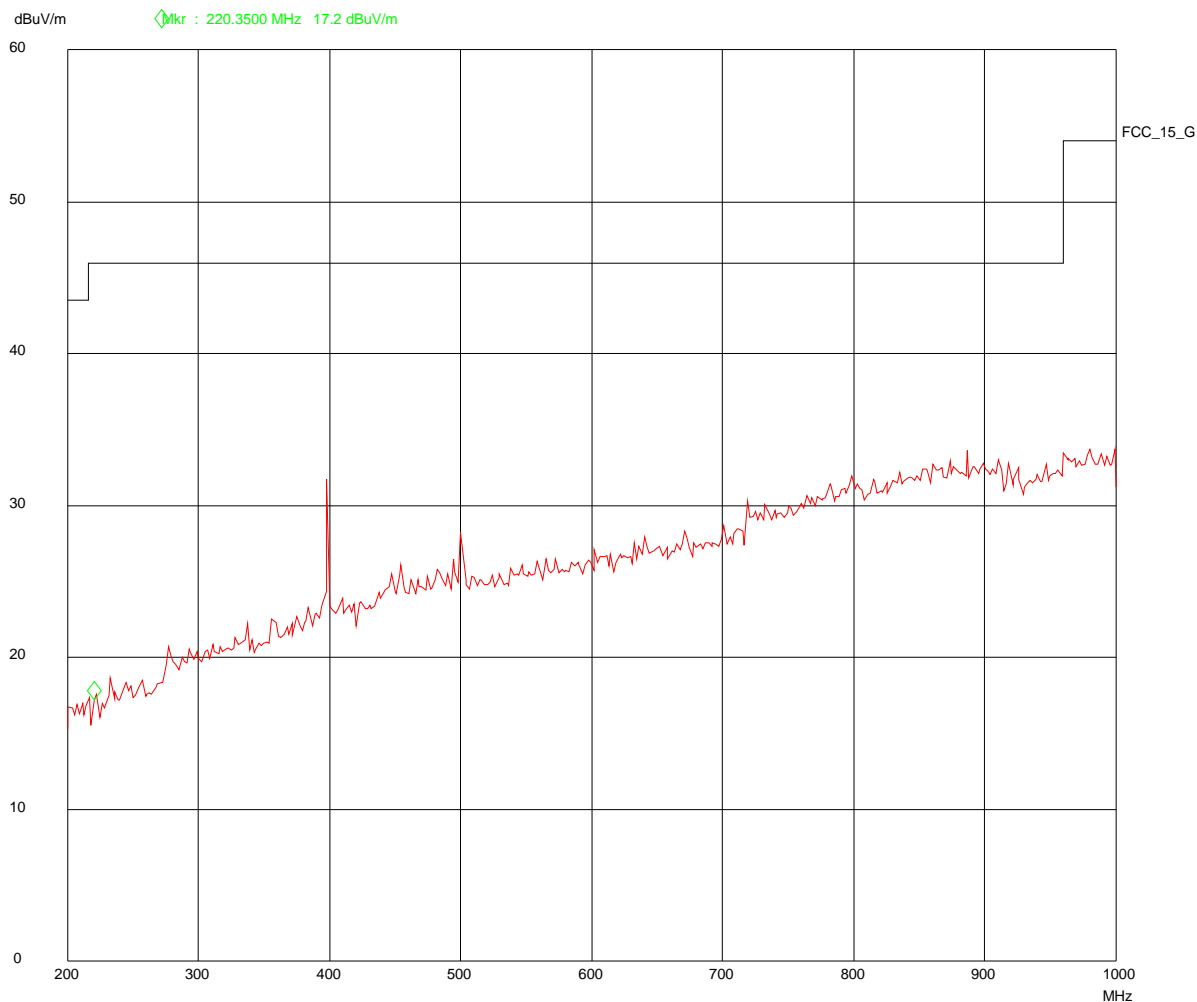
Peak

Operator: EH
Comment: Nera Satcom AS
WorldPro 1000
FCC 15209
HP 2m
Distance 3 m

Scan Settings (1 Range)

|----- Frequencies -----| |----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB

Transducer No.	Start	Stop	Name
21	200M	1000M	HL223



200-1000 MHz, horizontal polarization, measuring distance 3 m

NEMKO COMLAB AS

02. Nov 05 15:13

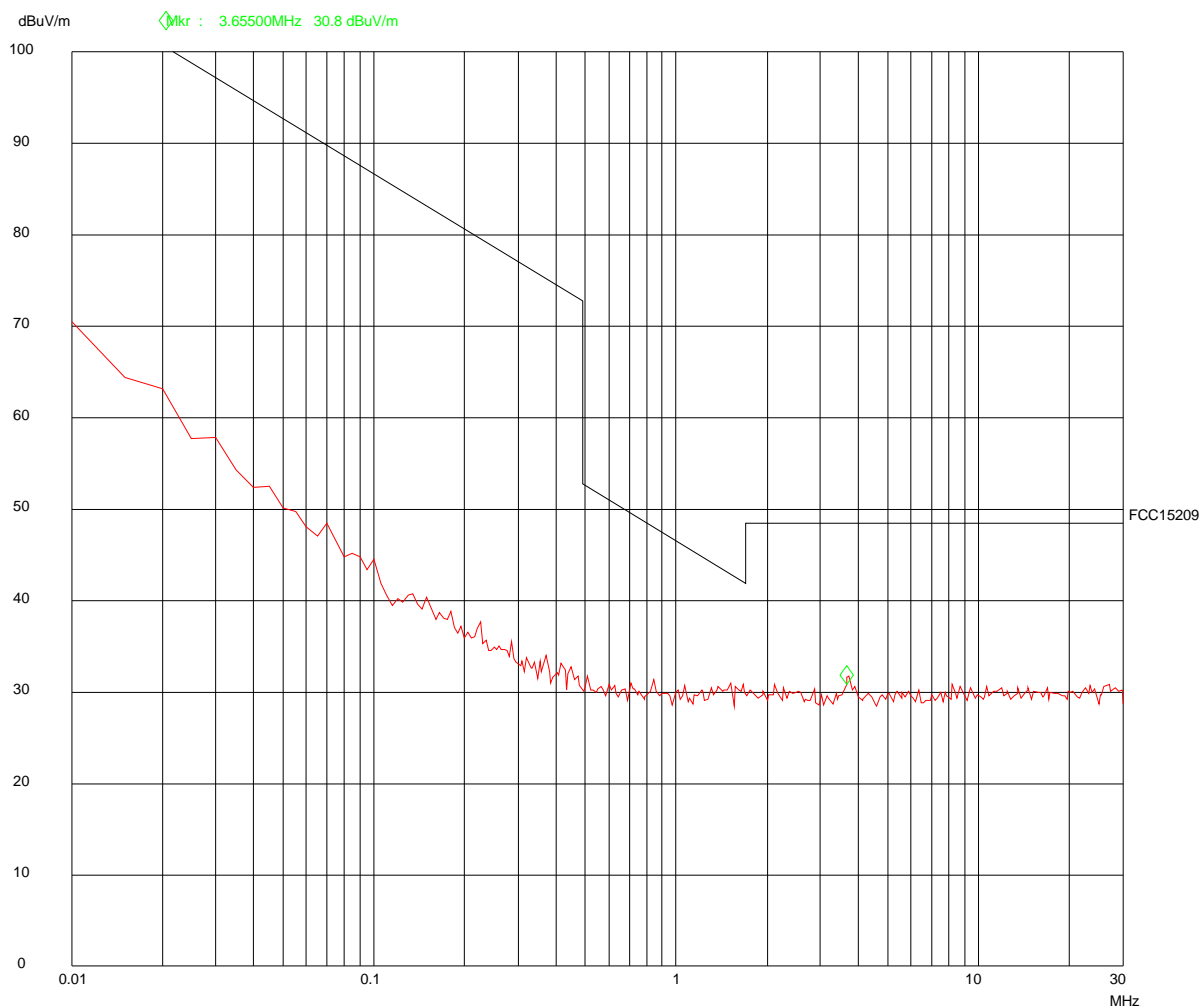
Peak

Operator: EH
Comment: Nera Satcom AS
WorldPro 1000
FCC 15209
Loop antenna
Distance 10 m

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
10k	30M	5k	9k	PK	50ms	AUTO	LN ON	60dB

Transducer No.	Start	Stop	Name
13	10k	30M	HFH2Z2



Radiated 150 kHz-30 MHz, measuring distance 10 m

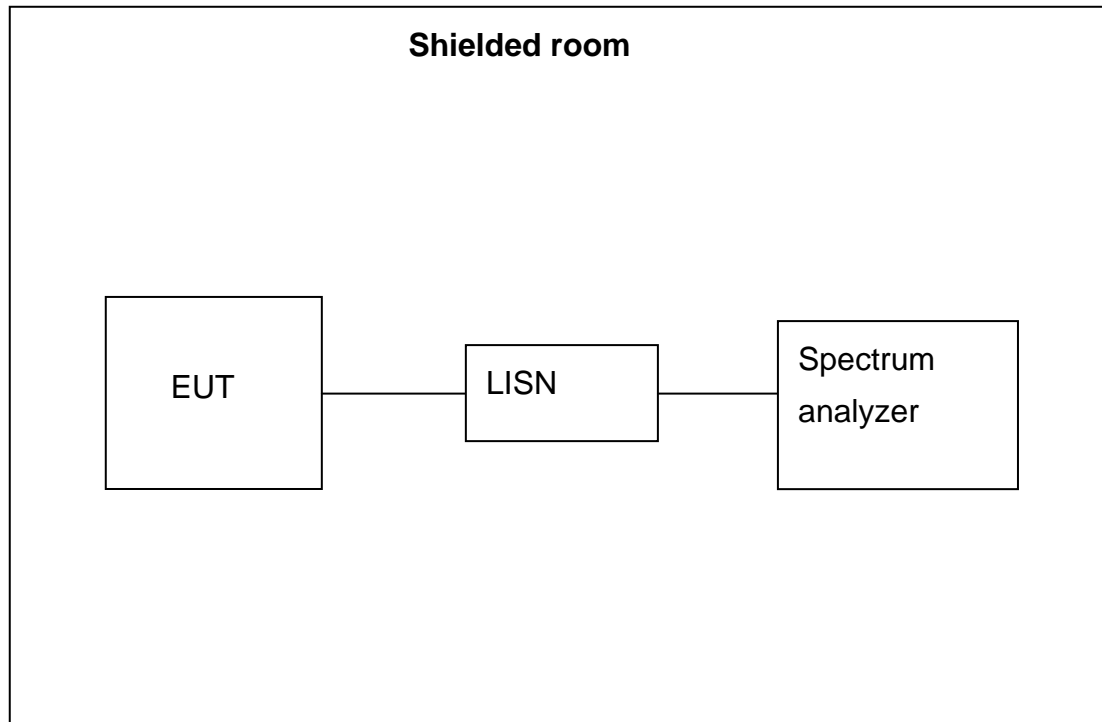
5 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

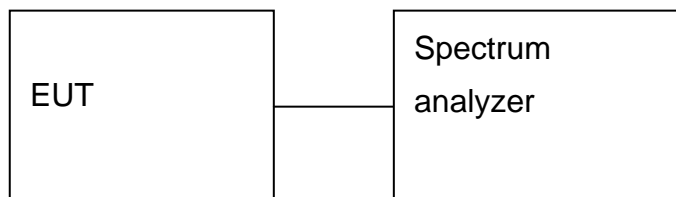
No.	Instrument/ancillary	Type of instrument/ancillary	Manufacturer	Ref. no.
1	FSEK	Spectrum Analyzer	Rohde & Schwarz	LR 1337
2	ESAI	Spectrum Analyzer	Rohde & Schwarz	LR 1090
3	3115	Antenna horn	EMCO	LR 1330
4	643	Antenna horn	Narda	LR 093
5	642	Antenna horn	Narda	LR 220
6	PM7320X	Antenna horn	Siverts lab	LR 103
7	DBF-520-20	Antenna horn	Systron Donner	LR 101
8	638	Antenna horn	Narda	LR 098
9	5VF1000/2000	BP filter	Trilithic	LR 1174
10	5VF2000/4000	BP filter	Texscan	LR 42
11	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076
12	8449B	Amplifier	Hewlett Packard	LR 1322
13	959C	Printer	Hewlett Packard	LR 1414
14	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285
15	10855A	Amplifier	Hewlett Packard	LR 1445
16	HL223	Antenna log.per	Rohde & Schwarz	LR 1261
17	HK116	Antenna biconic	Rohde & Schwarz	LR 1260
18	ESVS 30	Test Receiver	Rohde & Schwarz	LR 1101

6 BLOCK DIAGRAM

6.1 Powerline Conducted Emission



6.2 Peak Power Output



6.3 Test Site Radiated Emission

