TEST REPORT OF A 2.4 GHz RLAN PCMCIA CARD, BRAND NO WIRES NEEDED, TYPES SWALLOW 1100 AND FALCON 1100, IN CONFORMITY WITH FCC PART 15 AND ANSI C63.4-1992

FCC report layout endorsed by the FCC by Public Notice of March 11, 1992.

Accredited by	:	**STERLAB accreditation number L029 D.A.R., TTI-P-G.127/96-00**
Competent body	:	**Article 10-2 EMC Directive**
Notified body	:	**Article 10-5 EMC Directive Low Voltage Directive Number 0122 TTE Directive**
Designated laboratory	:	**TTE Directive**
Notified test service	:	**Automotive Directive**
FCC listed	:	**31040/SIT**
VCCI listed	:	**R 592 and C 507**
Certification body	:	**Electrical Products Safety Regulation Hong Kong**

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NMi International B.V. (27239176)

MEASUREMENT/TECHNICAL REPORT

No Wires Needed B.V.

Models : Swallow 1100, Falcon 1100

FCC ID: OGD 10330209

July 7, 1999

This report concerns (check one):	Original grant	~~Class II change~~
Equipment type: Direct Sequence Spread Spectrum Transceiver		
Deferred grant requested per 47 CFR 0.457(d)(1)(ii)?	~~yes~~	no
If yes defer until: _____		
No Wires Needed, Jan Steen laan 5, 3723 BS Bilthoven, The Netherlands agrees to notify the Commission by _____ of the intended date of announcement of the product so that the grant can be issued on that date.		
Transition Rules Request per 15.37	~~yes~~	no
If no, assumed Part 15, Subpart B for unintentional radiators – the new 47 CFR (10-1-90 Edition) provision.		

Report prepared by:	Name	: Jan S. Sikkema B.Sc. E.E.
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	Country	: The Netherlands

The data taken for this test and report herein was done in accordance with FCC Part 15 and measurement Procedures of ANSI C63.4-1992 and were relevant the procedures as specified in the sheets from the FCC attached to this test report. NMi Certin B.V. at Niekerk, The Netherlands, certifies that the data is accurate and contains a true representation of the emission-profile of the Equipment Under Test (EUT) on the date of the test noted in the test report. I have reviewed the test report and find it to be an accurate description of the test(s) performed and the EUT so tested.

Date: July 7, 1999 Signature:

P.A.J.M. Robben
Department EMC and Telecommunication

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1 General information.

1.1 Product description.

The No Wires Needed 2.4 GHz Radio LAN PCMCIA card, type Swallow 1100 (referred to as EUT in this report), functions as an extension of any Ethernet network. Portable PC's equipped with No Wires Needed Swallow 1100 Wireless LAN PC Cards have full access to the enterprise network from anywhere in the facility where No Wires Needed Parrot 1100 Access Points are installed. It fits to any laptop PC that operates under Windows and provides access to the wireless LAN through a small integrated antenna. The Swallow 1100 features high-speed wireless connection, up to 11 Mbps and supports full mobility and seamless roaming from cell to cell (handover). The air interface is interoperable with IEEE 802.11.

The EUT is powered from the Laptop Personal Computer and does not have an external power supply.

The Falcon 1100 consists of a Swallow 1100 PCMCIA card inserted in a PCMCIA to ISA slot converter.

1.2 Related Submittal(s)/Grant(s).

Not applicable.

1.3 Tested System Details.

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (included inserted cards, which have Grants) are:

Model	Serial #	FCC ID	Description	Cable Descriptions
EUT: Swallow 1100	-	OGD 10330209	PCMCIA 2.4 GHz RLAN	- direct connection with laptop PC
Toshiba PA1224E YV	11615720	n.a.	Laptop PC	- unshielded power cord to adapter
HP Deskjet 500	3228S37407	B94C2106X	Printer	- printer cable to Laptop PC - power cord to adapter
Microsoft Mouse	n.a.	C3K7PN9937	Mouse	- mouse cable to laptop PC

1.4 Test Methodology.

The test methodology used has been based on the requirements of FCC Part 15, (10-1-97 edition), relevant clauses 15.205, 15.207, 15.209 and 15.247,. The used measuring methods are based on the ANSI C63.4-1992 document.
Radiated tests above 30 MHz were performed at a distance of 3 meter. Below 30 MHz the measurement was carried out on a distance of 10 meter. The eventual found results will be calculated to values for the required measuring distance of 30/300 meter.
Fieldstrength measurements on frequencies above 1 GHz were measured with appropriate pre-amplifiers, antennas and a spectrum analyzer. On found frequencies the actual level at the input of the pre-amplifier was generated with aid of a signal generator. The output level of the signal generator was increased with the antenna-factor to obtain the fieldstrength.

1.5 Test Facility

The FCC has per Public Notice declared that the measurement facilities located at the NMi Certin B.V. Testsite Niekerk, Smidshornerweg 18, The Netherlands, has been reviewed and found to be in compliance with the requirements of section 2.948 (previously section 15.38) of the FCC rules per August 2, 1994.

The description of the measuring facilities have been filed with reference 31040/SIT, 1300B3 at the FCC's Offices.

1.6 List of measurement equipment.

NMi number	Description	Brand	Type
12471	Biconical antenna 20MHz-200MHz	EATON	94455-1
12473	Log-per antenna 200-1000MHz	EATON	96005
12475	Loop antenna	EMCO	6502/2
12476	Antenna mast	EMCO	TR3
12477	Antenna mast 1-4 mtr	Poelstra	--
12478	Control unit / portable turn table	NMi	DFO
12483	Guidehorn	EMCO	3115
12484	Guidehorn	EMCO	3115
12486	Spectrum analyzer	Anritsu	MS2601A
12488	Guidehorn 18-26.5 GHz	EMCO	RA42-K-F-4B-C
12491	Measuring receiver 0.01Mhz-30MHz	R&S	ESH3
12492	Measuring receiver 20MHz-1300MHz	R&S	ESVP-
12493	EZM Spectrum Monitor	R&S	EZM
12494	Measuring receiver 20MHz-1000 MHz	R&S	ESV-
12497	Spectrum analyzer	HP	8592A
12498	Rejectfilter	K&L	3TNF-100/200-N
12499	Rejectfilter	K&L	3TNF-50/100-N
12500	Rejectfilter	K&L	3TNF-250/500-N
12501	Rejectfilter	K&L	3TNF-25/50-N
12507	Artificial mains network 3-phase	R&S	ESH2-Z5
12516	Signalgenerator 100kHz-1000MHz	R&S	SMX
12519	RF amplifier	ENI	603L
12524	Signalgenerator	R&S	SMHU
12525	POCSAG generator	NMi	SMF-3
12527	Signalgenerator 100kHz-1000 MHz	R&S	SMG

12528	ERMES generator	NMi	--
12533	Signalgenerator	MARCONI	2032
12538	Attenuator 100W/20dB	Bird electronic	8340-200
12545	Directional coupler	HP	HP778D
12546	Measuring cable to plateau	--	RG 213
12548	Meas.cable 2 metre, color:green	Radiall	R287571005
12549	Oscilloscope 20 MHz	KENWOOD	CS-8010
12553	Communication Analyzer	R&S	CMTA 84
12558	Communication Analyzer	R&S	CMTA 54
12559	Digital storage oscilloscope	Le Croy	9310M
12560	DC Power Supply 20A/60V	DELTA	SM6020
12561	DC Power Supply 20A/70V	DELTA	SM7020D
12567	Plotter	HP	7440A
12605	calibrated dipole 28MHz-1GHz	Emco	3121c
12607	Calibrated attenuator set	HP	HP11581a
12608	HF milliwattmeter	HP	HP435a
12609	Power sensor 10MHz-18GHz	HP	HP8481A
12620	Spectrum analyzer	Advantest	R4131B
12635	Measurement platform	WOLFF	--
12636	Plastic measurement room	Polyforce	--
12640	Temperature chamber	Heraeus	VEM03/500
13078	Wideband Pre-Amplifier (1GHz-5GHz)	Miteq	AMF3D0100503010
13313	Impuls limiter	R&S	ESH3Z2.357...
13452	Digital multi meter	HP	34401A
13664	Spectrum analyzer	HP	HP8593E
13886	Open Area Test Site	Comtest	--
14051	Anechoic room	Comtest	--
14277	Antennamast 4m	Heinrich Deisel	HD100
14278	Controller OATS	Heinrich Deisel	MA240
14340	Biconilog antenna 20MHz - 1100MHz	EMCO	3143
14351	Biconilog	EMCO	9143
14450	2.4 GHz bandrejectfilter	BSc	xn-1783
14987	Stripline cell	Marconi	TC5010
15232	Tektronics storage scope	Tektronics	--
15453	Magnetic loop	Chase	--
15633	Biconilog Testantenna	Chase	CBL 6111B
15667	Measuring receiver 9kHz - 2750MHz	R&S	ESCS30
99012	ITU-R recomm. 559-2 noise generator	NMi	--
99040	Attenuator 25W/20dB	Bird electronic	8340-200
99041	Attenuator 25W/10dB	BIRD	8340-100
99042	Attenuator 10W/3dB	Bird electronic	8304-030-N
99043	Attenuator 25W/20dB	Bird electronic	8340-200
99044	Attenuator 10W/3dB	Bird electronic	8304-030-N
99045	DC Power Supply 3A/30V	DELTA	E030/3
99046	Fluke Multimeter	John Fluke	12
99050	Wideband Pre-Amplifier (5GHz-10GHz)	Miteq	AMF3D0501004010
99055	Non-conducting support	NMi	--
99056	Isolating transformer 1:1	NMi	--
99061	Non-conducting support 150cm	NMi	--
99068	Detector N-F/BNC-F	Radiall	R451576000
99069	Cable 5m RG214	NMi	--
99070	Cable 15m RG214	NMi	--
99071	Cable 10m RG214	NMi	--
99076	Bandpassfilter 4-10GHz	Reactel	7AS-7G-6G-511
99077	Regulating trafo	RFT	LTS006
99079	RF Combiner	R&S	DVU 4
99108	Turntable OATS	Heinrich Deisel	HD050
99111	magnetic loop power supply	Chase	--
99112	Tripod	Chase	--
99115	Voltage probe	Schwarzbeck	TK9416

1.7 Bandwidth and antenna factors.

The utilized measuring equipment is stated in § 1.6. The bandwidth of the receiver switches automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. Also the antennafactors are included in the testreceiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate correction factor for the cable loss. The total correction is automatically added to the measured value.

2 Product labelling.

2.1 FCC ID Label

The following label shall be attached to the device under test.

FCC ID: OGD 10330209
This Device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Figure 2.1. FCC ID Caller

The dimensions of the label, the location of the label and the type of font can be found in the FCC regulation book CFR 47, parts 0 to 19, revised as per October 1, 1993.

2.2 Location of the FCC ID Label on the EUT

The FCC ID Label will be placed on the backside of the Radio LAN PCMCIA card

See attached documentation-sheet for more detailed information.

3 System test configuration.

3.1 Justification.

The system was configured for testing in a typical fashion (as a customer would normally use it)

The justification of cables and equipment has been carried out as prescribed in the ANSI C63.4-1992 document.

The measurements were performed on the lowest operating frequency (channel 1: 2412 MHz), the operating frequency in the middle of the specified frequency band (channel 6: 2437 MHz) and the highest operating frequency (channel 11: 2462 MHz).

Operating frequencies and rated output power levels

channel	operating frequencies (MHz)	Rated output power (dBm)	test performed
1	2412	20	yes
2	2417	20	no
3	2422	20	no
4	2427	20	no
5	2432	20	no
6	2437	20	yes
7	2442	20	no
8	2447	20	no
9	2452	20	no
10	2457	20	no
11	2462	20	yes

Table 3.1: Operating frequencies and rated output power levels

To complete the configuration required by the FCC, the transmitter was tested in laptop PC with the antenna connected to the antenna port.

The transmitter antenna connector is a unique reverse-thread and is non-interchangeable.

3.2 EUT exercise software.

The EUT was enabled to continuously transmit, which was verified by a receiving unit during testing. The carrier was also checked to verify that the information was being transmitted.

3.3 Special accessories.

No special accessories are used to achieve FCC compliance.

3.4 Equipment modifications.

No modifications have been made to the equipment to achieve compliance.

Applicant Signature	: n.a.	Date	: n.a.
Typed/Printed Name	: n.a.	Position	: n.a.

3.5 Configuration of the tested system.

Blockdiagrams of the tested system are included in Annex attached to this report.

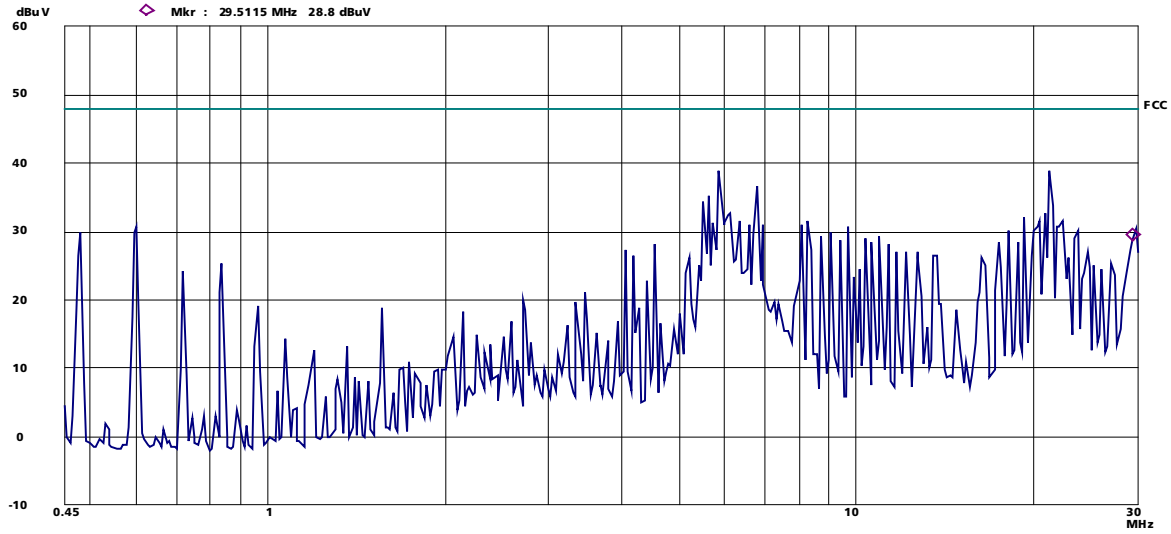
4 Block diagram(s) of the tested model.

Information is annexed in the technical documentation supplied by the applicant.

5 Conducted emission data.

The initial step in collecting conducted data is a scan of the measurement range. Significant signals are then marked and these signals are then measured using quasi-peak.

Line 1



Plot 5.1: Conducted emissions on channel 6.

The following table lists worst case conducted emission data in accordance with FCC 15.207. The conducted test was performed with the EUT exercise program loaded. Photographs of the testsetups are included in annex 1 attached to this report.

Frequency (MHz)	Measurements results QP (dBµV)	Margin (dBµV)	Limits (dBµV)
0.38	32.3	15.7	48.0
0.59	30.2	17.8	48.0
4.54	28.3	19.7	48.0
5.49	33.9	4.1	48.0
5.63	38.8	9.2	48.0
5.85	40.6	7.4	48.0
6.81	38.2	9.8	48.0
21.29	39.1	8.9	48.0
29.74	30.9	17.1	48.0
other frequencies	<<	>20	48.0

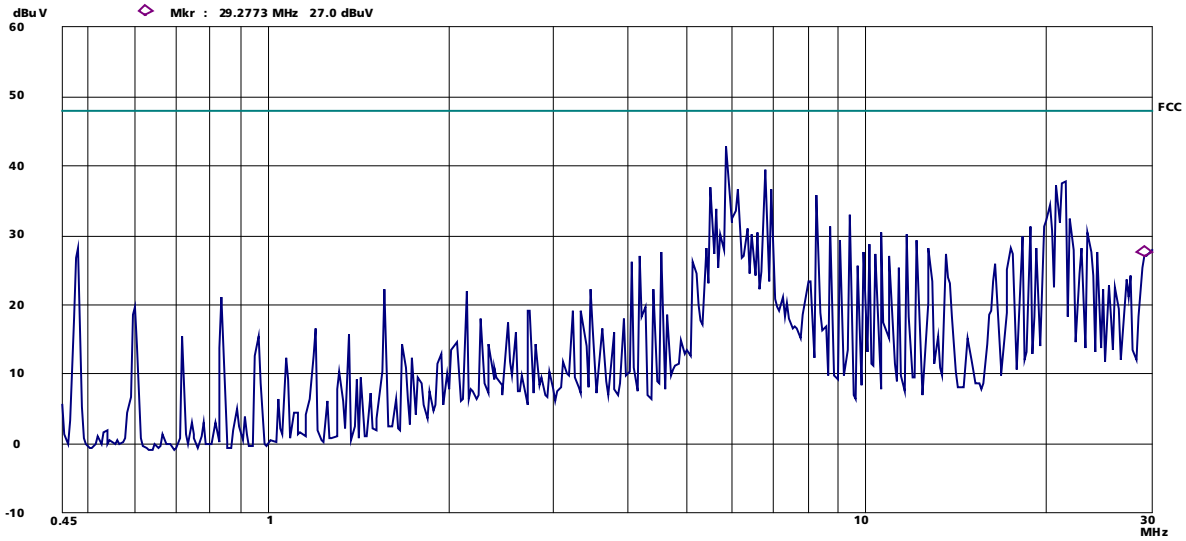
Table 5.1 : Conducted emissions on channel 6.
<< means that the measured value is more than 20 dB below limit // QP means Quasi-Peak

The conducted emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:
Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

Neutral L2



Plot 5.2: Conducted emissions on channel 6.

The following table lists worst case conducted emission data in accordance with FCC 15.207. The conducted test was performed with the EUT exercise program loaded. Photographs of the testsetups are included in annex 1 attached to this report

Frequency (MHz)	Measurements results QP (dBμV)	Margin (dBμV)	Limits (dBμV)
4.54	29.3	18.7	48.0
5.19	29.1	18.9	48.0
5.63	37.3	10.7	48.0
5.85	38.5	9.5	48.0
6.81	37.6	10.4	48.0
8.38	28.6	9.4	48.0
20.78	37.9	10.1	48.0
21.63	34.1	13.9	48.0
29.52	31.3	16.9	48.0
other frequencies	<<	>20	48.0

Table 5.2 : Conducted emissions on channel 6.
<< means that the measured value is more than 20 dB below limit // QP means Quasi-Peak

The conducted emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:

Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

6 Radiated emission data

The following data lists the significant emission frequencies (worst case), measured levels in accordance with FCC 15.209. Photographs of the testsetups are included in annexes attached to this report.

6.1 Radiated emissions Swallow with integral antenna

Vertical polarization			
Frequency	Measured Value QP (3m)	FCC limit	FCC margin
MHz	dbuV/m	dbuV/m	dB
32.0	33.6	40	-6.4
48.0	22.8	40	-17.2
66.6	19.5	40	-20.5
72.0	27.9	40	-12.1
80.0	25.7	40	-14.3
88.4	27.2	40	-12.8
107.9	27.2	40	-12.8
120.0	36.5	43.5	-7
126.0	25.3	43.5	-18.2
136.0	35.2	43.5	-8.3
143.9	34.7	43.5	-8.8
168.0	39.1	43.5	-4.4
180.0	37.6	43.5	-5.9
301.5	34.9	46	-11.1
310.5	36.3	46	-9.7
2157.2	35.8	54	-18.2

Table 6.1: Radiated emissions on channel 6 of Swallow 1100 (Vertical)

Notes:
All measured levels in quasi-peak mode, polarization refers to measuring antenna, negative margin means it is below the limit. All radiated harmonic emissions were found to be > 25dB below limits.

The radiated emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:

Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

Horizontal polarization			
Frequency	Measured Value QP (3m)	FCC limit	FCC margin
MHz	dbuV/m	dbuV/m	dB
32	32	40	-8
48.02	22.8	40	-17.2
66.6	16.4	40	-23.6
72	27.2	40	-12.8
80	24.6	40	-15.4
88.4	26.1	40	-13.9
107.9	27.9	40	-12.1
120.04	32.6	43.5	-10.9
126	26.5	43.5	-17
136	33.6	43.5	-9.9
143.9	34.3	43.5	-9.2
168	34.7	43.5	-8.8
180	34.8	43.5	-8.7
301.49	37.1	46	-8.9
310.45	35.6	46	-10.4
2157.2	38.1	54	-15.9

Table 6.2: Radiated emissions on channel 6 of Swallow 1100 (Horizontal)

Notes:
All measured levels in quasi-peak mode, polarization refers to measuring antenna, negative margin means it is below the limit. All radiated harmonic emissions were found to be > 25dB below limits.

The radiated emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:

Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

6.2 Radiated emissions Swallow with external antenna

Vertical polarization			
Frequency	Measured Value QP (3m)	FCC limit	FCC margin
MHz	dbuV/m	dbuV/m	dB
32.0	36.9	40.0	-3.1
48.0	24.7	40.0	-15.3
66.6	21.2	40.0	-18.8
72.0	31.8	40.0	-8.2
80.0	27.2	40.0	-12.8
88.4	28.9	40.0	-11.1
107.9	30.0	40.0	-10.0
120.0	39.2	43.5	-4.3
126.0	30.1	43.5	-13.4
136.0	38.1	43.5	-5.4
143.9	37.9	43.5	-5.6
168.0	40.3	43.5	-3.2
180.0	38.2	43.5	-5.3
301.5	39.7	46.0	-6.3
310.5	40.1	46.0	-5.9
2157.2	36.1	54.0	-17.9

Table 6.1: Radiated emissions on channel 6 of Swallow 1100 (Vertical)

Notes:
All measured levels in quasi-peak mode, polarization refers to measuring antenna, negative margin means it is below the limit. All radiated harmonic emissions were found to be > 25dB below limits.

The radiated emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:

Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

Horizontal polarization			
Frequency	Measured Value QP (3m)	FCC limit	FCC margin
MHz	dbuV/m	dbuV/m	dB
32.0	33.0	40.0	-7.0
48.0	23.8	40.0	-16.2
72.0	28.2	40.0	-11.8
80.0	23.7	40.0	-16.3
88.4	27.4	40.0	-12.6
107.9	28.4	40.0	-11.6
120.0	35.1	43.5	-8.4
126.0	28.3	43.5	-15.2
136.0	36.2	43.5	-7.3
143.9	35.3	43.5	-8.2
168.0	36.6	43.5	-6.9
180.0	34.1	43.5	-9.4
301.5	35.2	46.0	-10.8
310.4	34.9	46.0	-11.1
2157.2	37.0	54.0	-17.0

Table 6.2: Radiated emissions on channel 6 of Swallow 1100 (Horizontal)

Notes:
All measured levels in quasi-peak mode, polarization refers to measuring antenna, negative margin means it is below the limit. All radiated harmonic emissions were found to be > 25dB below limits.

The radiated emission measurement has been carried out with AC supply voltage of 120 V.

Test personnel:

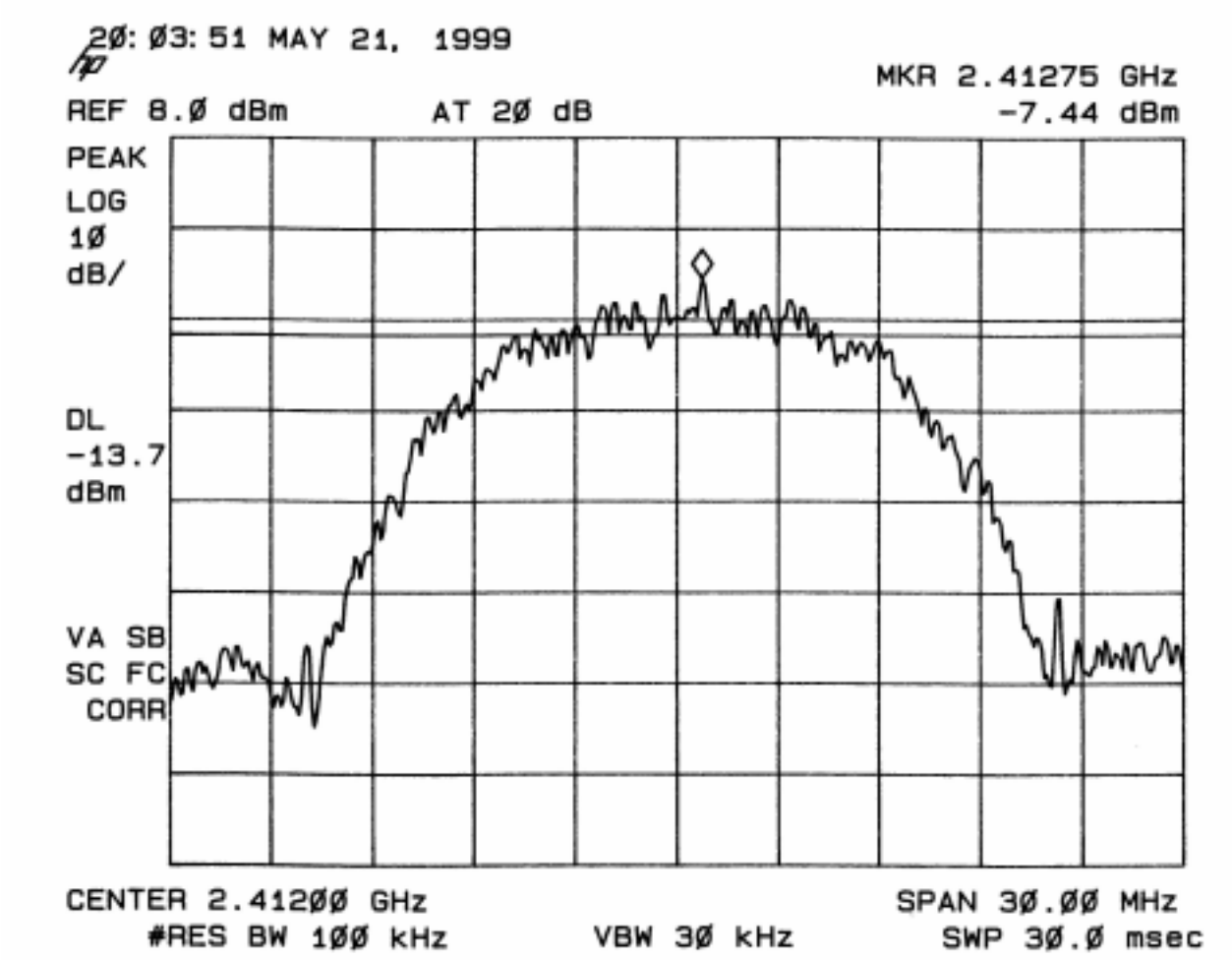
Tester signature : Date: May 23, 1999

Typed/Printed name : Jan S. Sikkema

7 -6 dB Bandwidth measurements.

The minimum 6 dB bandwidth measurement was performed in accordance with FCC 15.247 (a)

7.1 Channel 1



Plot 7.1: -6 dB bandwidth plot of channel 1

Modulation = 5.5 Mbps

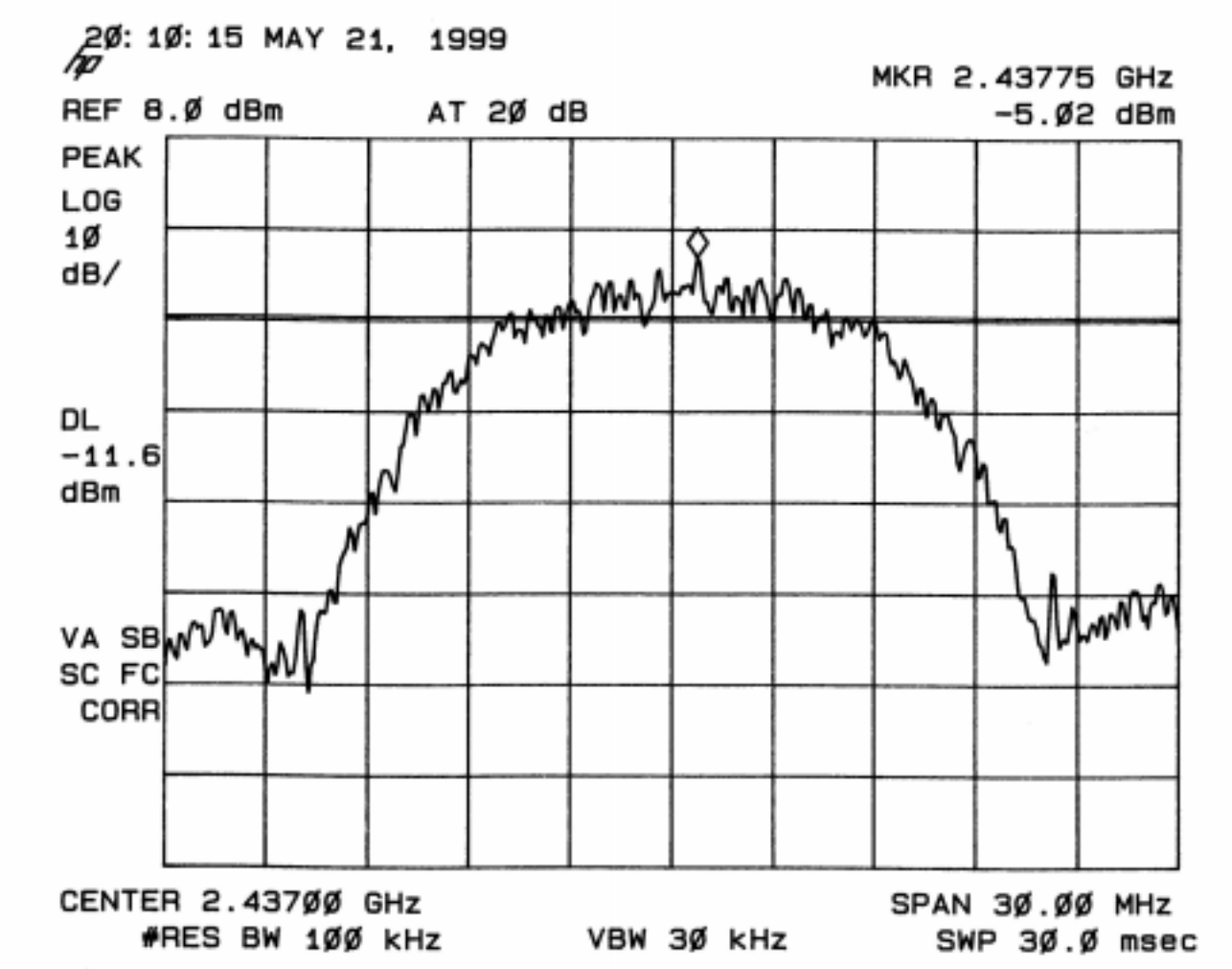
The minimum 6 dB modulated bandwith is on channel 1 : 10.65 MHz.

Test personnel:

Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

7.2 Channel 6



Plot 7.2: -6 dB bandwidth plot of channel 6

Modulation = 5.5 Mbps

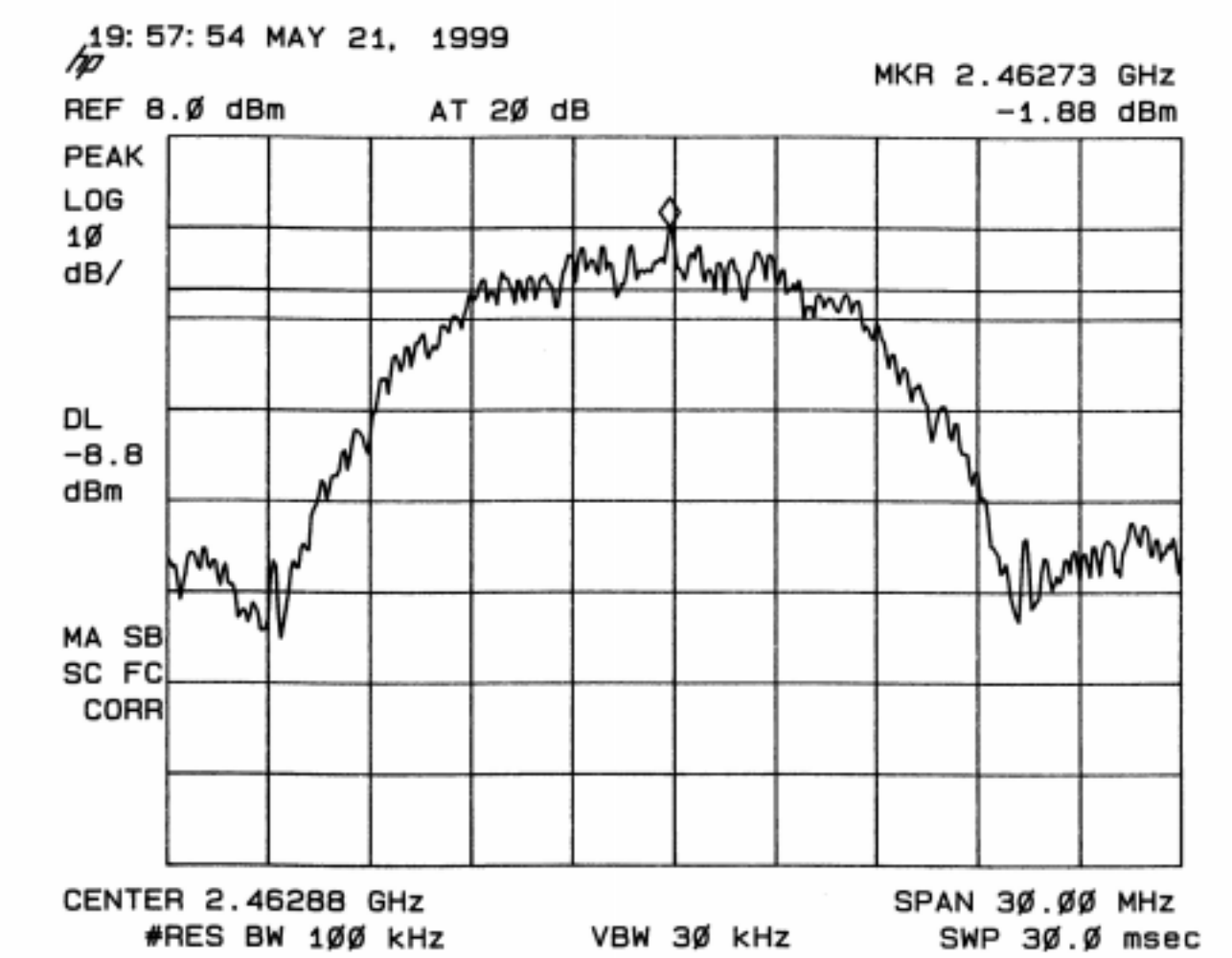
The minimum 6 dB modulated bandwith is on channel 6 : 10.72 MHz.

Test personnel:

Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

7.3 Channel 11



Plot 7.3: -6 dB bandwidth plot of channel 11

Modulation = 5.5 Mbps

The minimum 6 dB modulated bandwith is on channel 11 : 10.88 MHz.

Test personnel:

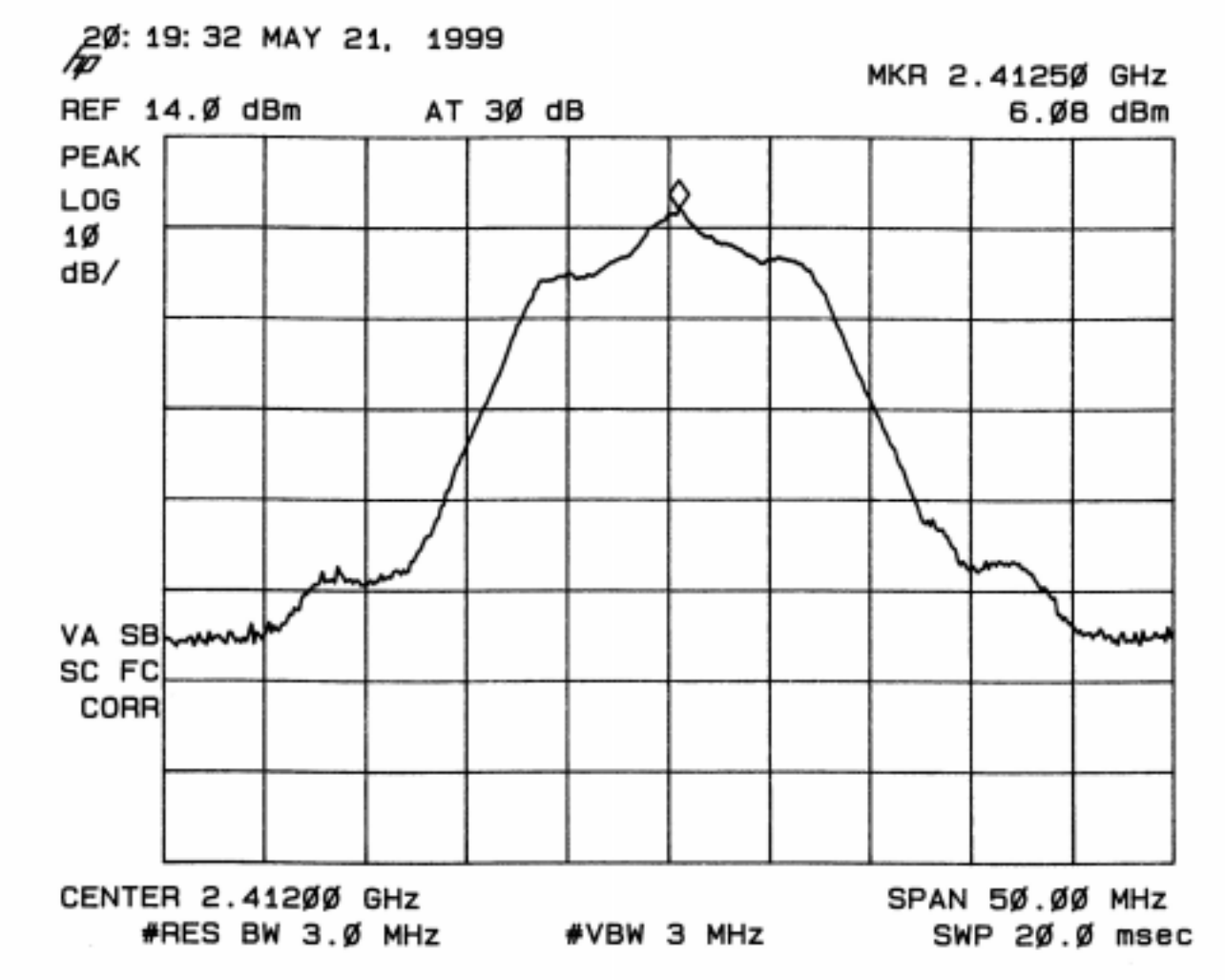
Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

8 Peak power

The peak power measurement was performed in accordance with FCC 15.247 (b). The plot is made with the highest bandwidth being worst case. The maximum value is then marked and the peak value of this signal is measured using a wideband diode detector.

8.1 Channel 1



Plot 8.1: Peak power plot of channel 1

Modulation = 5.5 Mbps

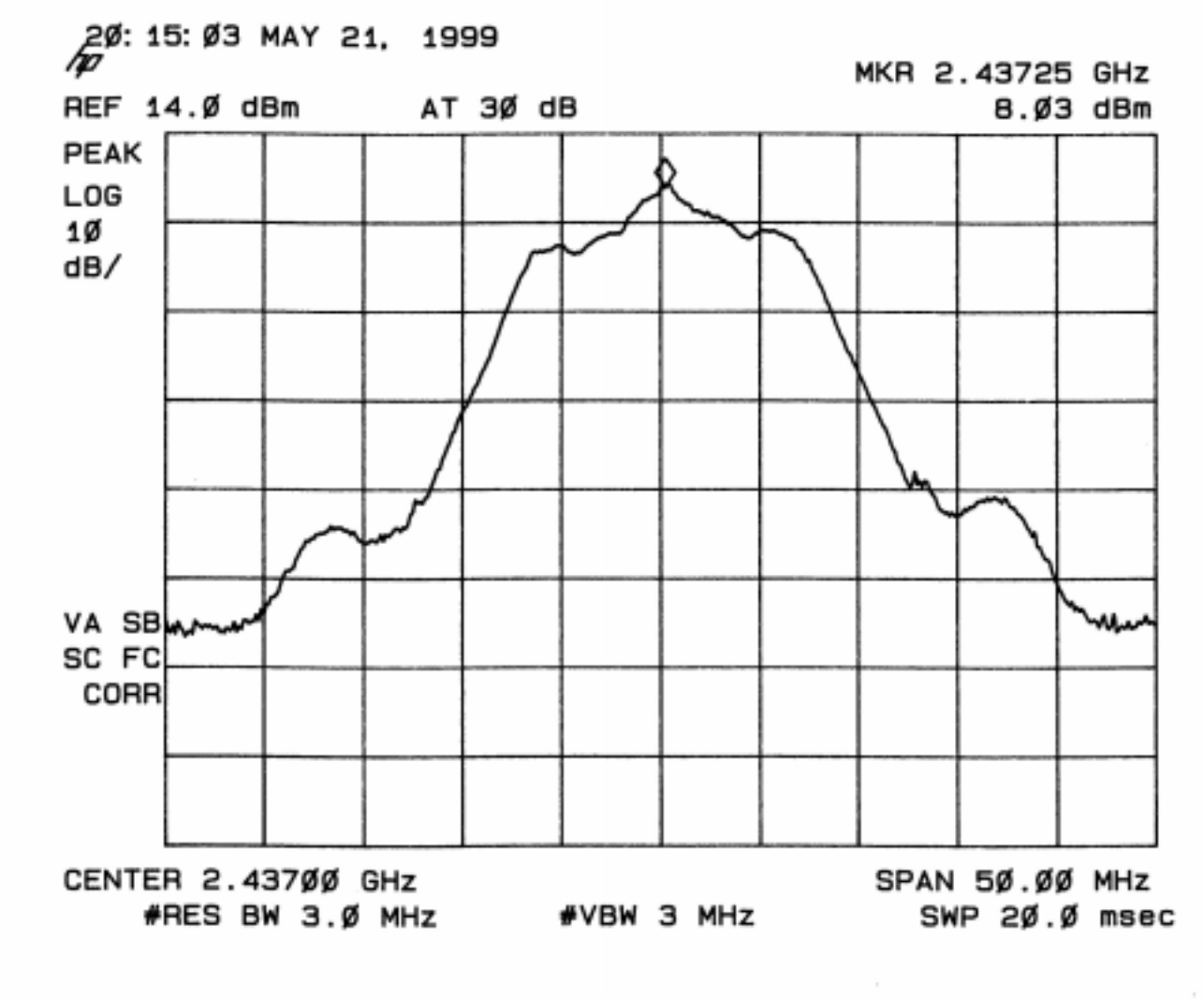
The maximum measured peak power on channel 1 : 7.10 dBm.

Test personnel:

Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

8.2 Channel 6



Plot 8.2: Peak power plot of channel 6

Modulation = 5.5 Mbps

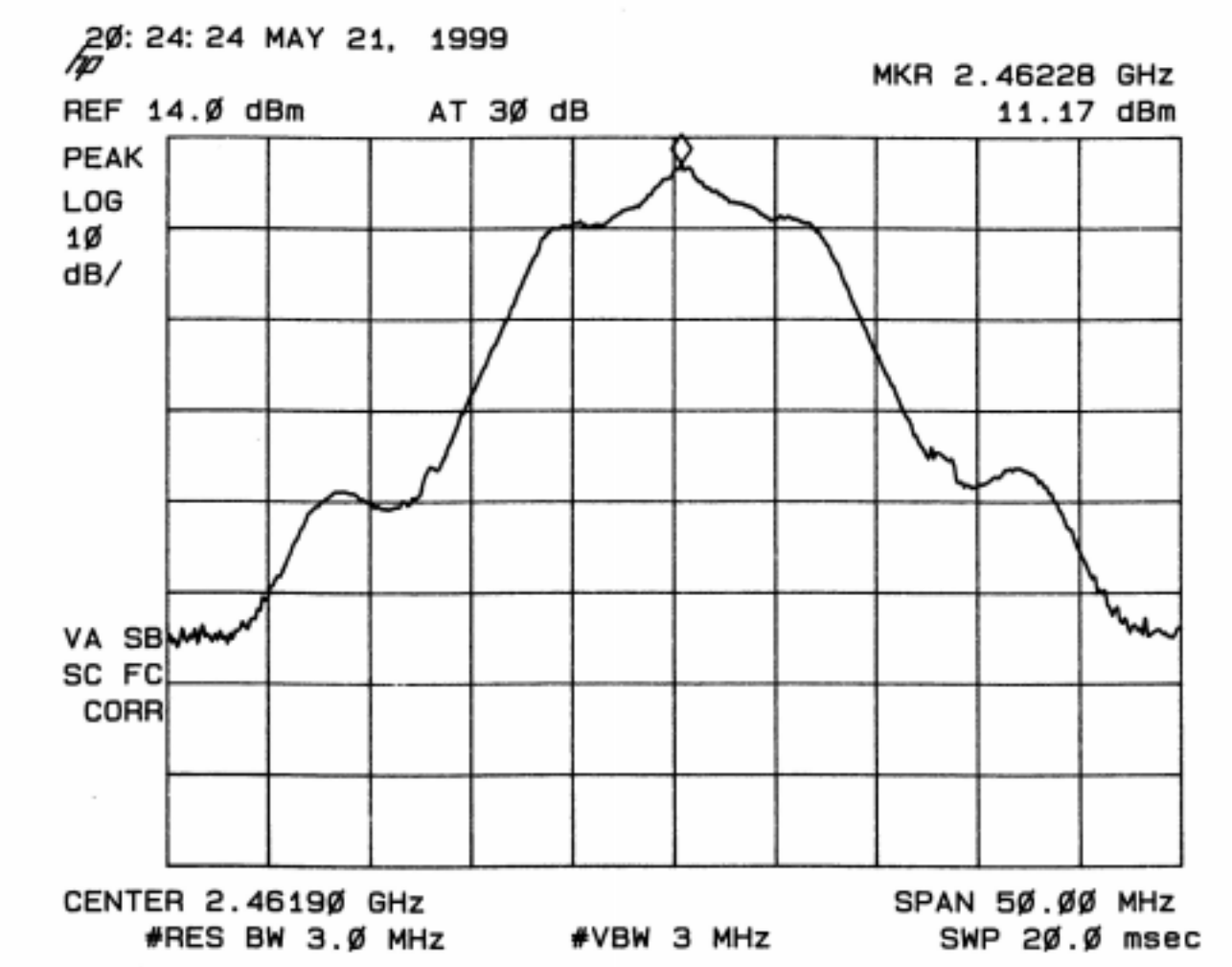
The maximum measured peak power on channel 6 : 8.8 dBm.

Test personnel:

Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

8.3 Channel 11



Plot 8.3: Peak power plot of channel 11

Modulation = 5.5 Mbps

The maximum measured peak power on channel 11 : 11.7 dBm.

Test personnel:

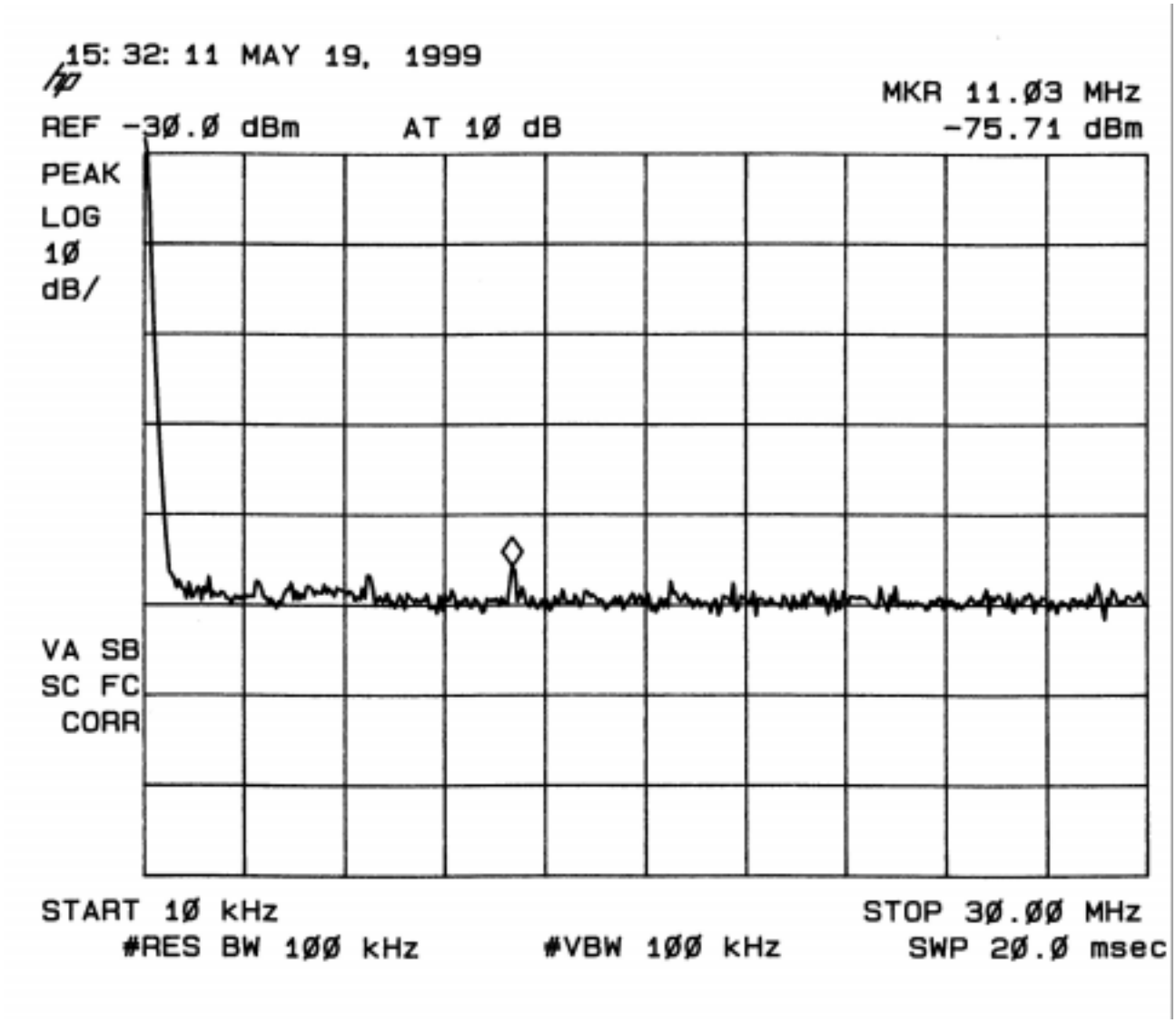
Tester signature : Date: May 21, 1999

Typed/Printed name : Jan S. Sikkema

9 Conducted emissions at the antenna output

Antenna spurious emission per FCC 15.247(c) was measured from the EUT antenna port using a 50 Ohm spectrum analyzer with the resolution/video bandwidth set at 100 kHz. The worst case values are plot below.

9.1 Channel 6

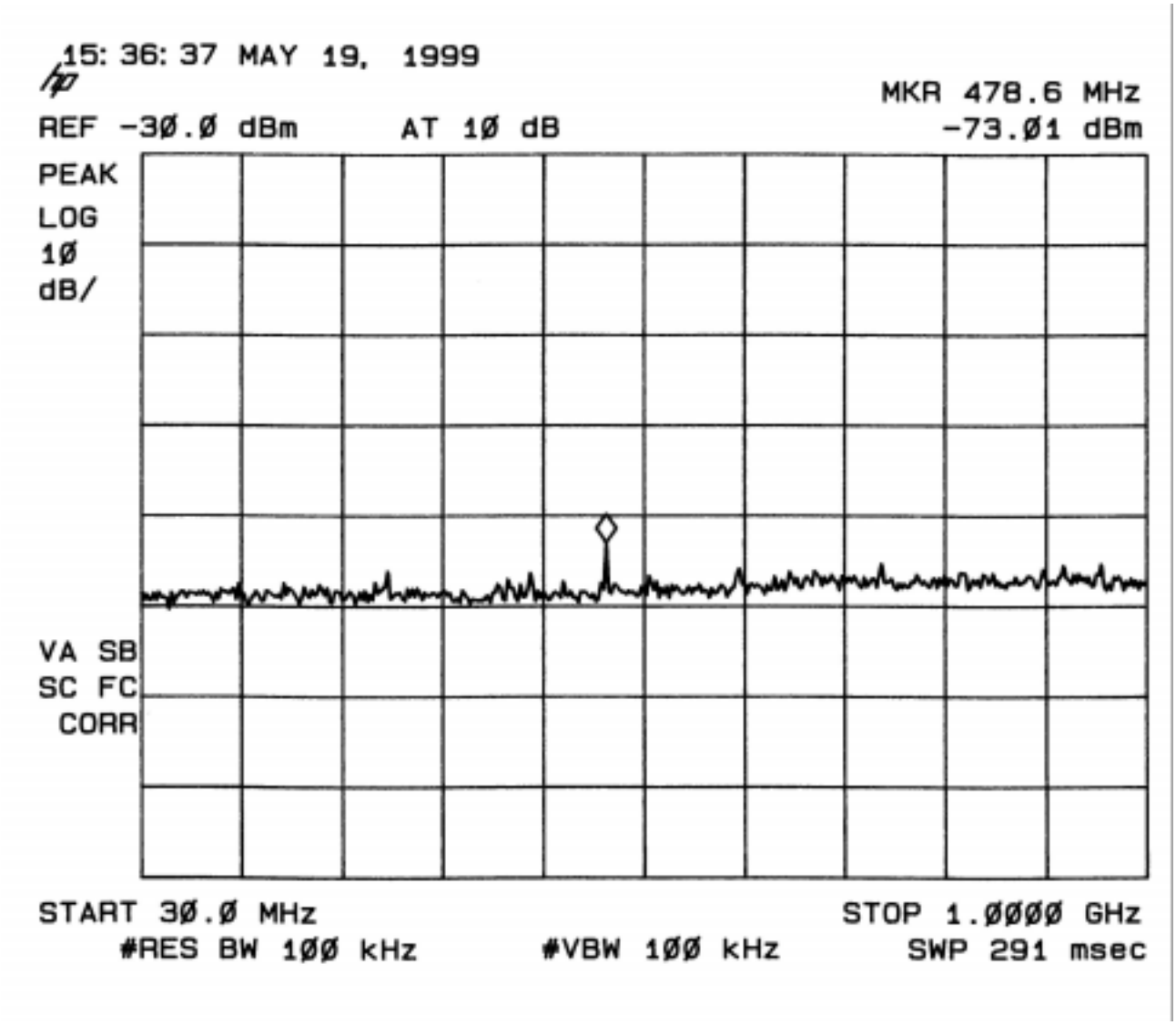


Plot 9.1: Conducted emissions 10.0 kHz – 30.0 MHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

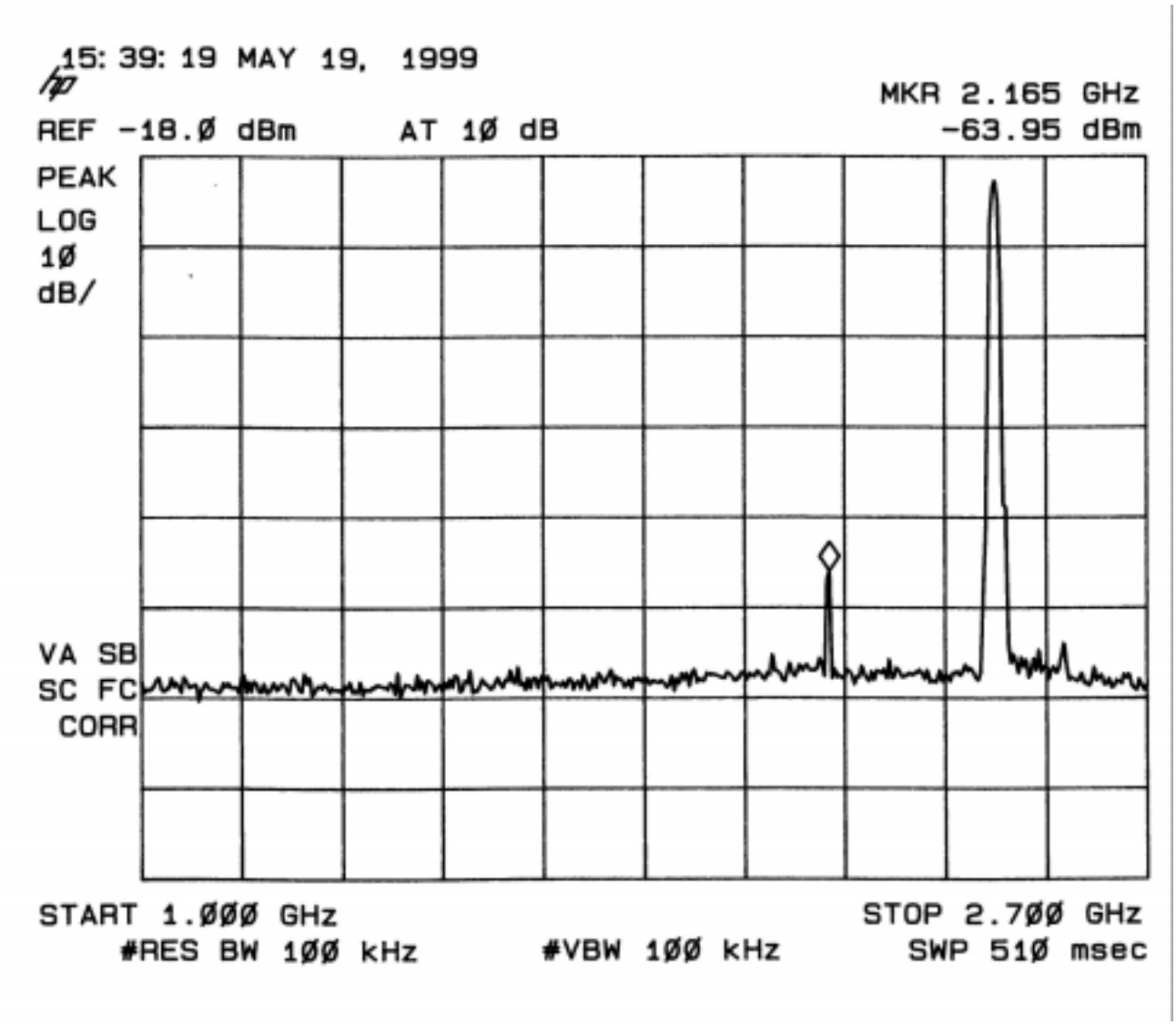


Plot 9.2: Conducted emissions 30 MHz – 1.0 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan Sikkema

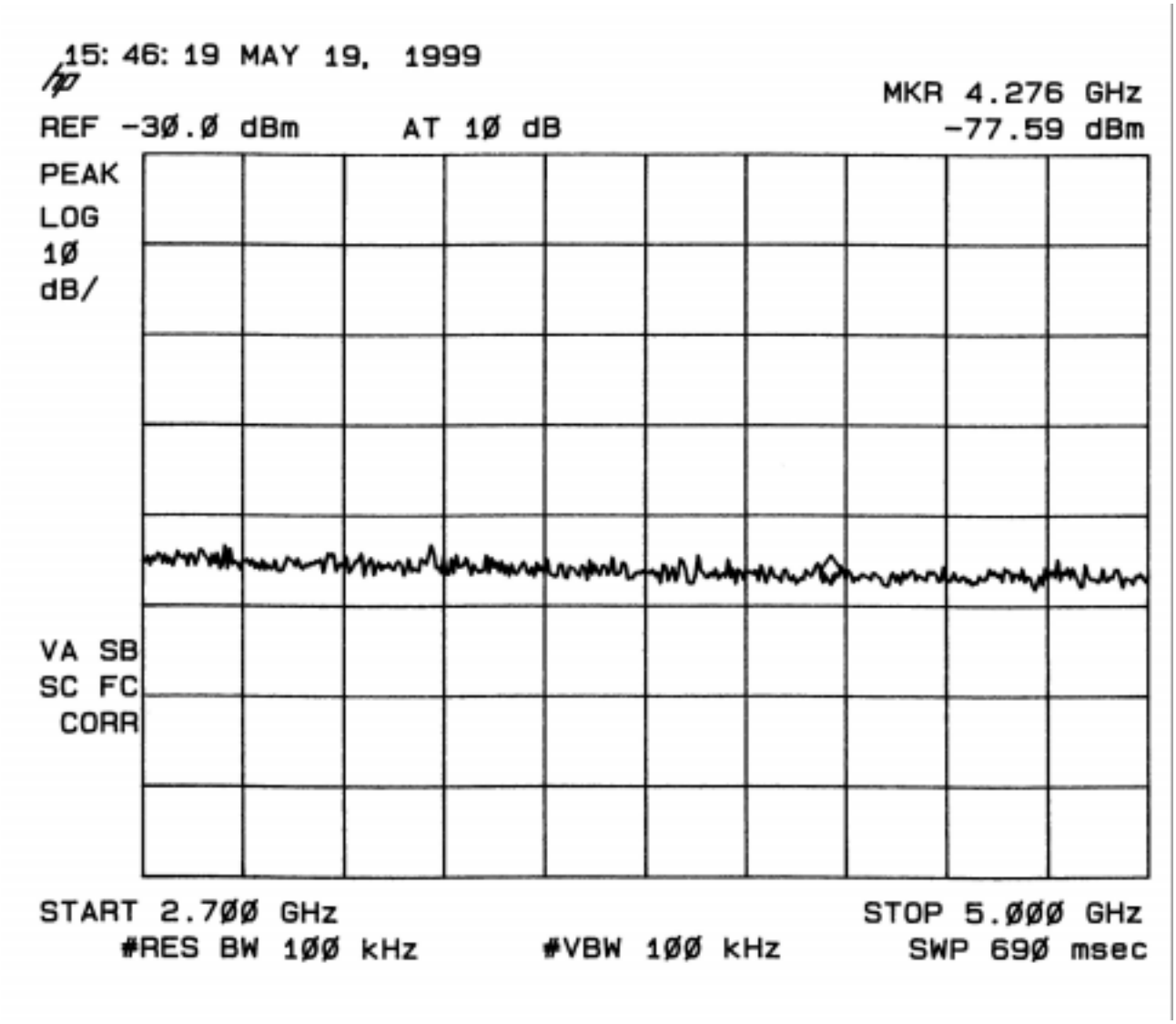


Plot 9.3: Conducted emissions 1.0 GHz – 2.7 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

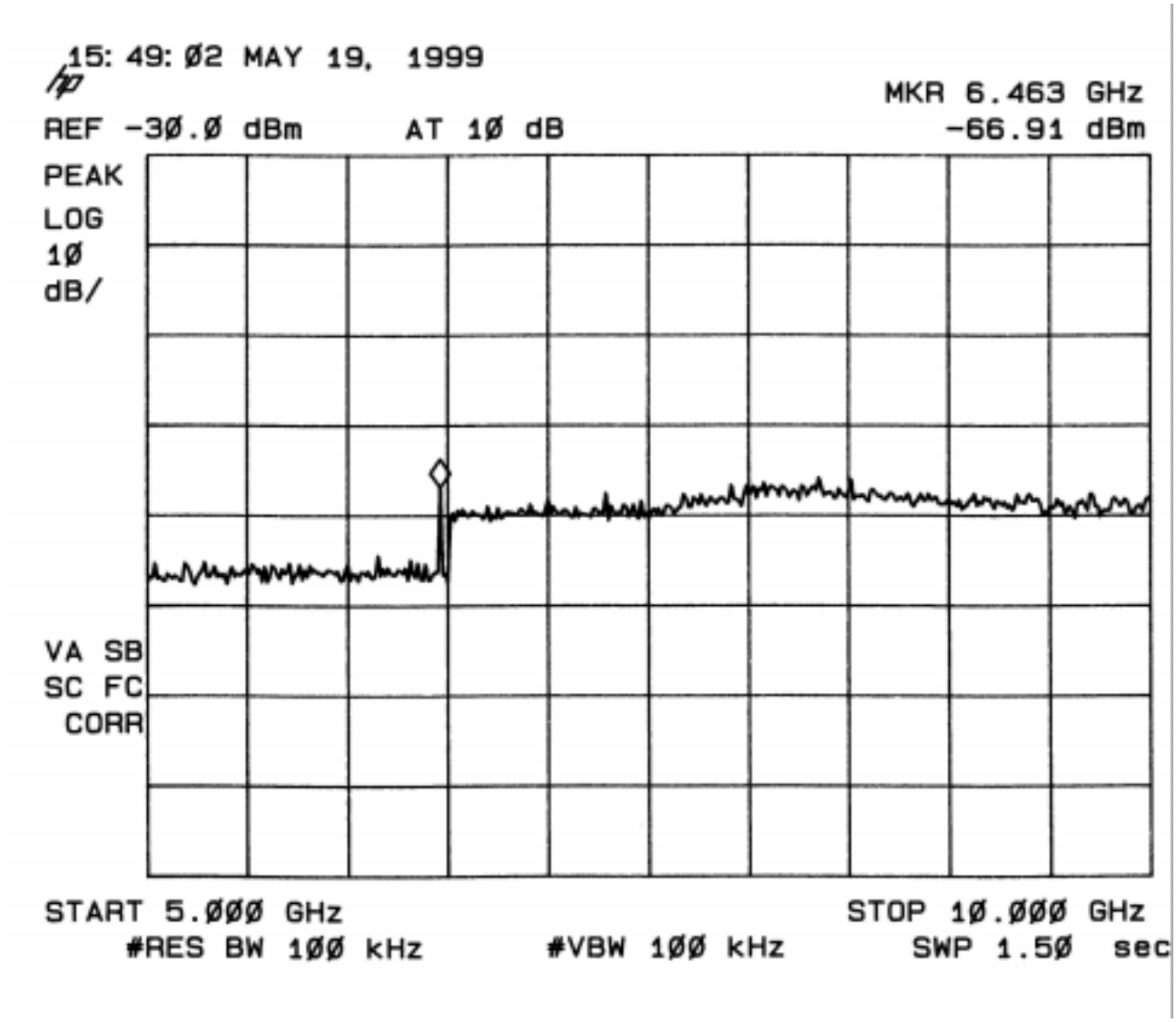


Plot 9.4: Conducted emissions 2.7 GHz – 5.0 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

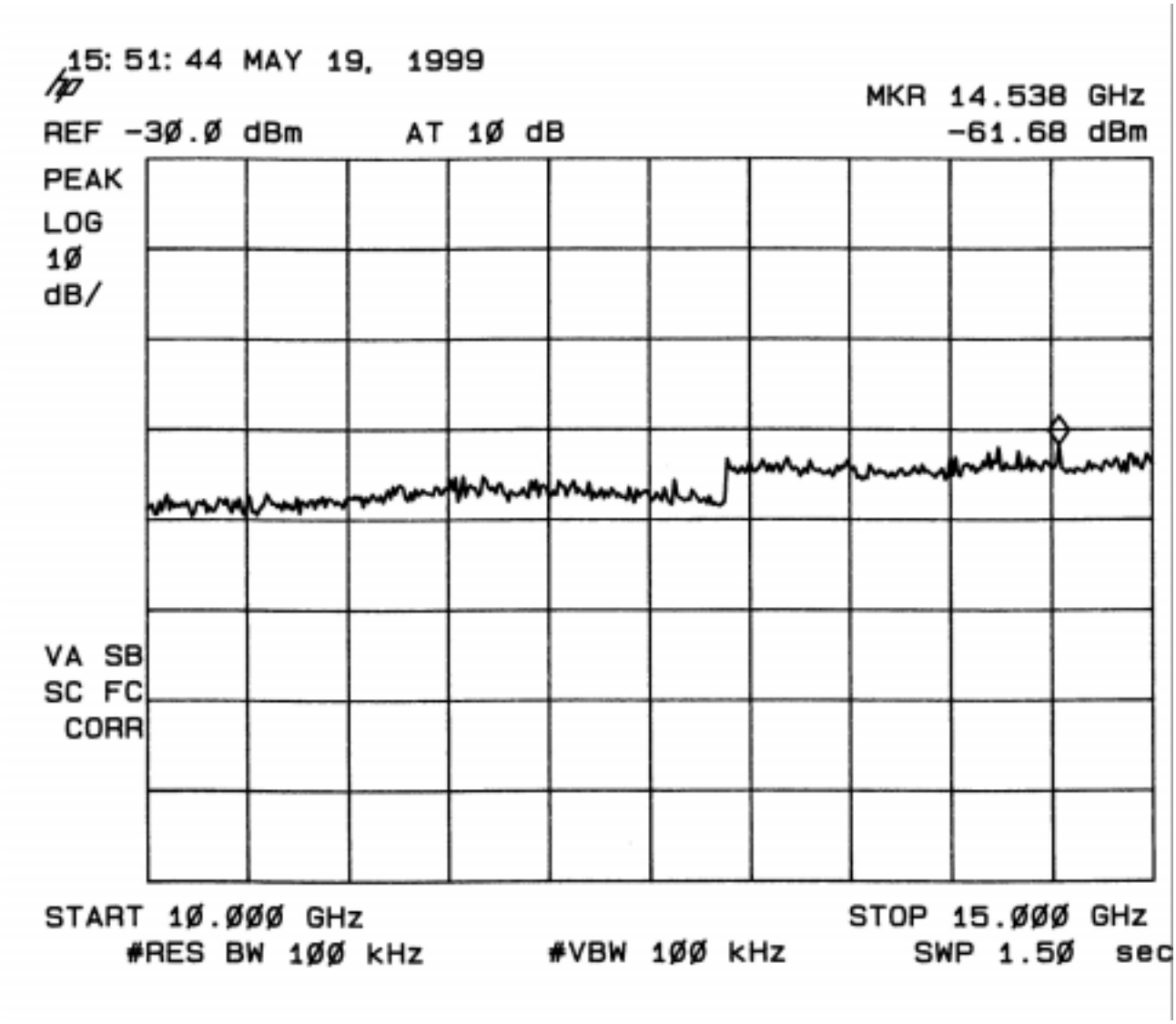


Plot 9.5: Conducted emissions 5.0 GHz – 10.0 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

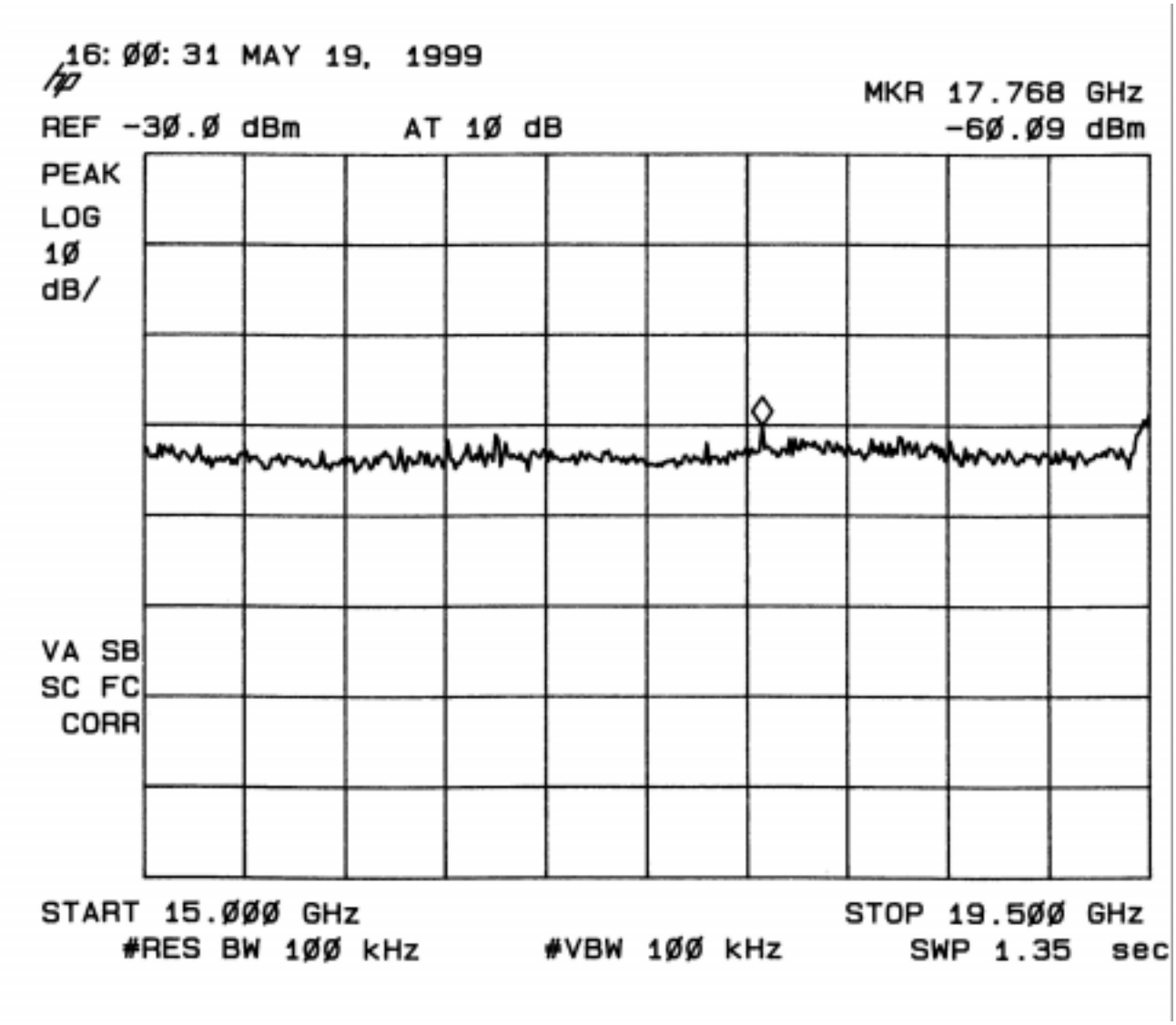


Plot 9.6: Conducted emissions 10.0 – 15.0 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

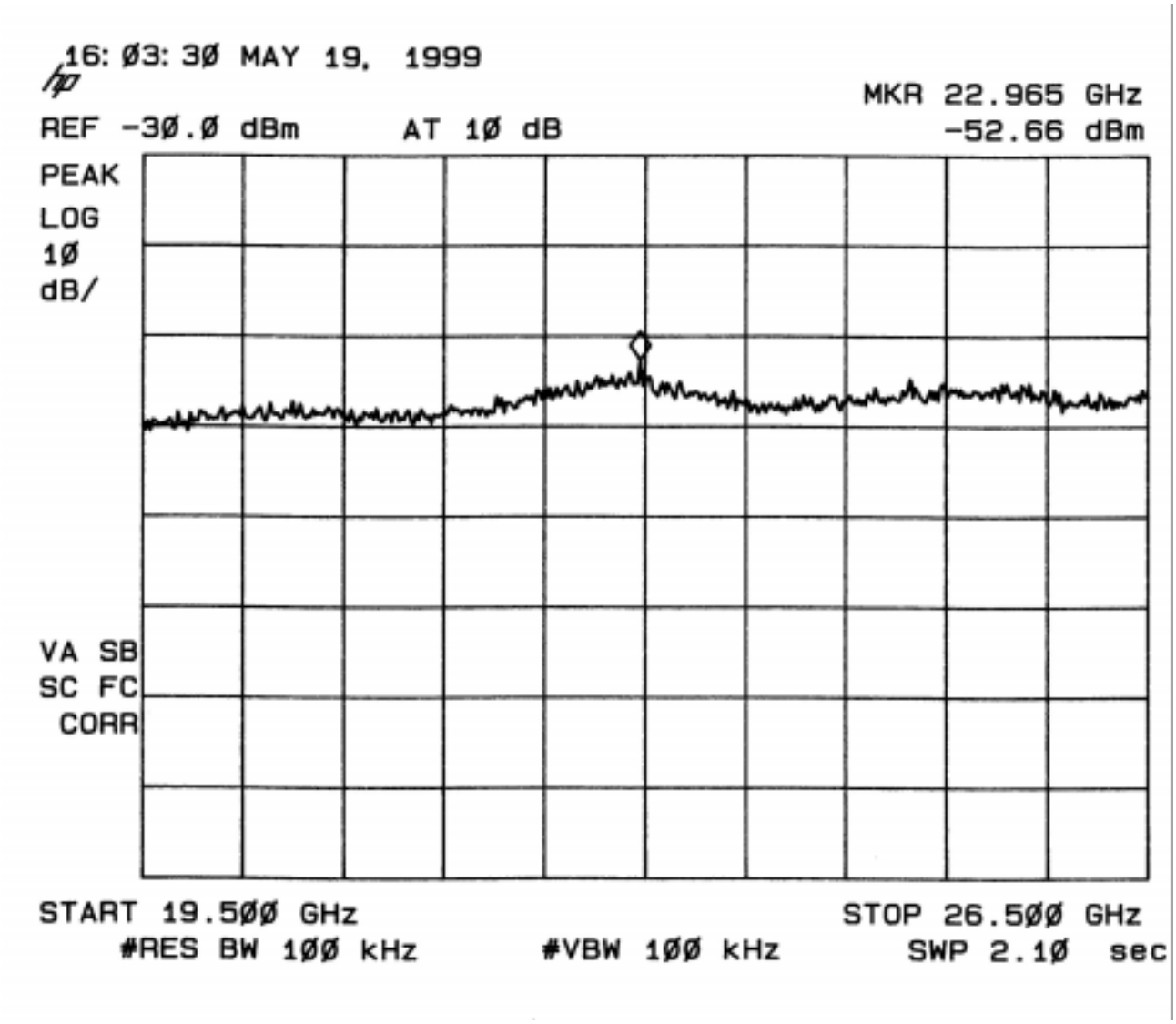


Plot 9.7: Conducted emissions 15.0 – 19.5 GHz

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema



Plot 9.8: Conducted emissions 19.5 – 26.5 GHz

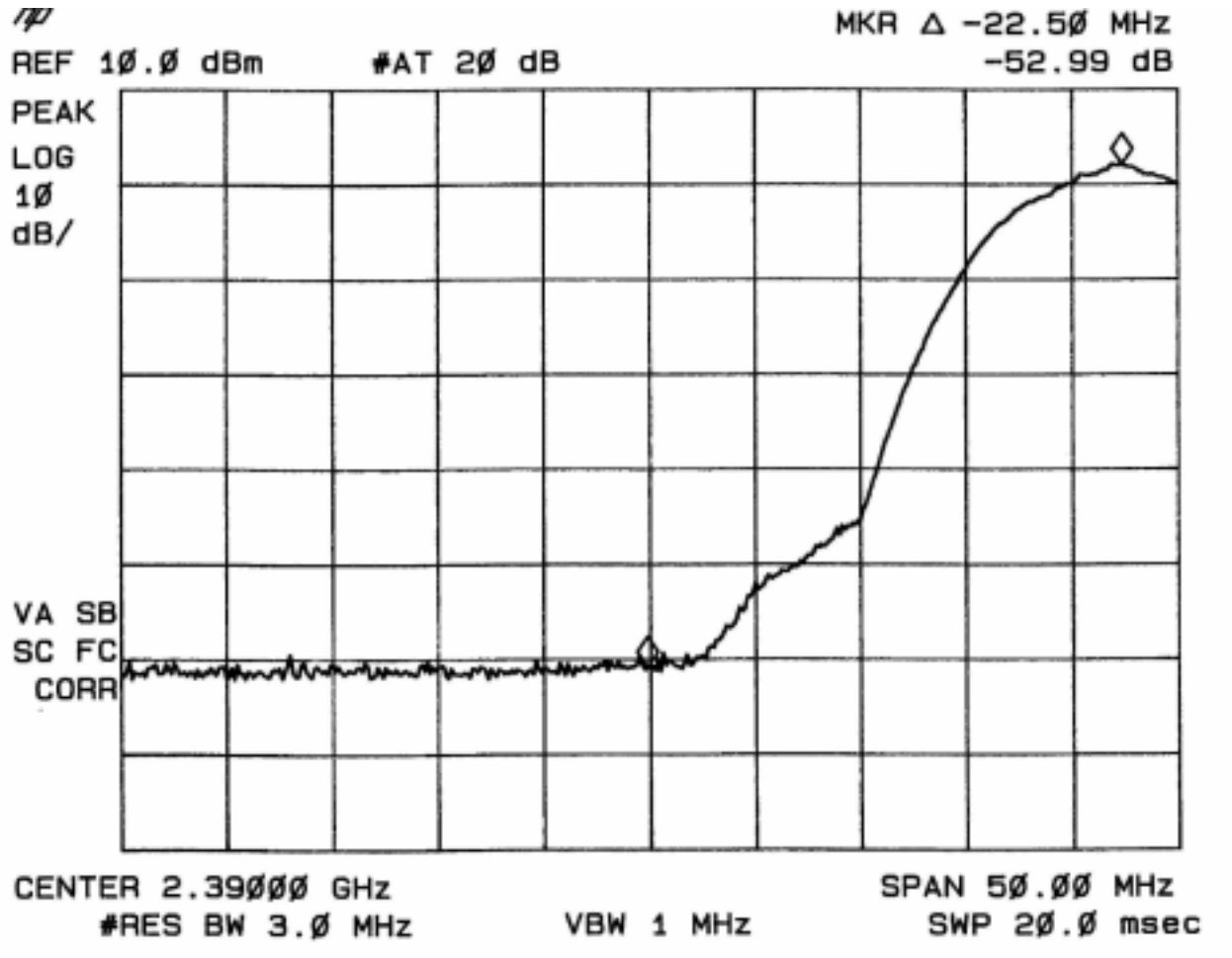
Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

10 Restricted bands of operation.

The following plots shows the maximum emissions at the band edges. The measurement was performed in accordance with FCC 15.247 (a)

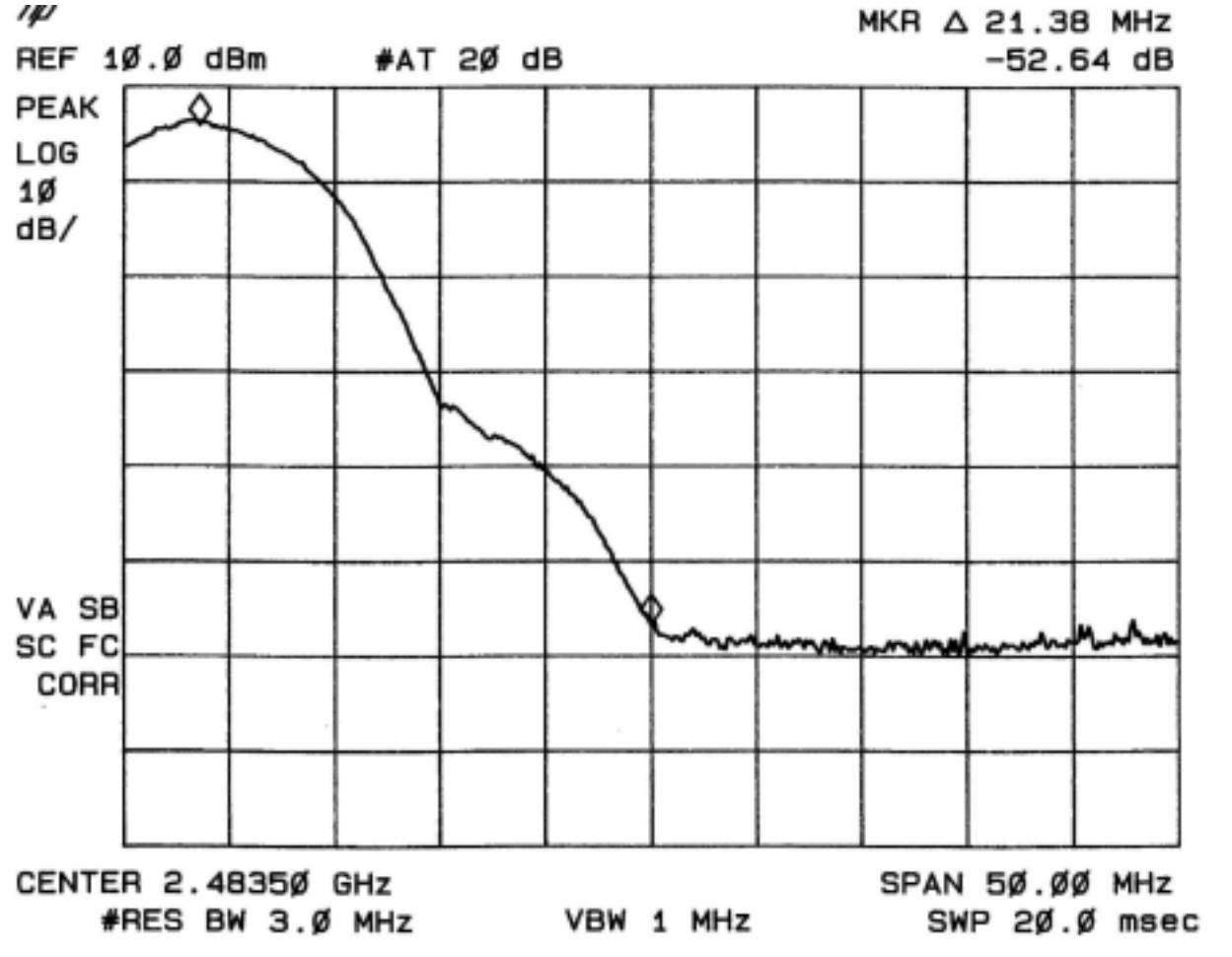


Plot 10.1: Conducted emissions at 2.390 GHz centre frequecy

Test personnel:

Tester signature : Date: June 17, 1999

Typed/Printed name : Jan S. Sikkema



Plot 10.2: Conducted emissions at 2.4835 GHz centre frequecy

Test personnel:

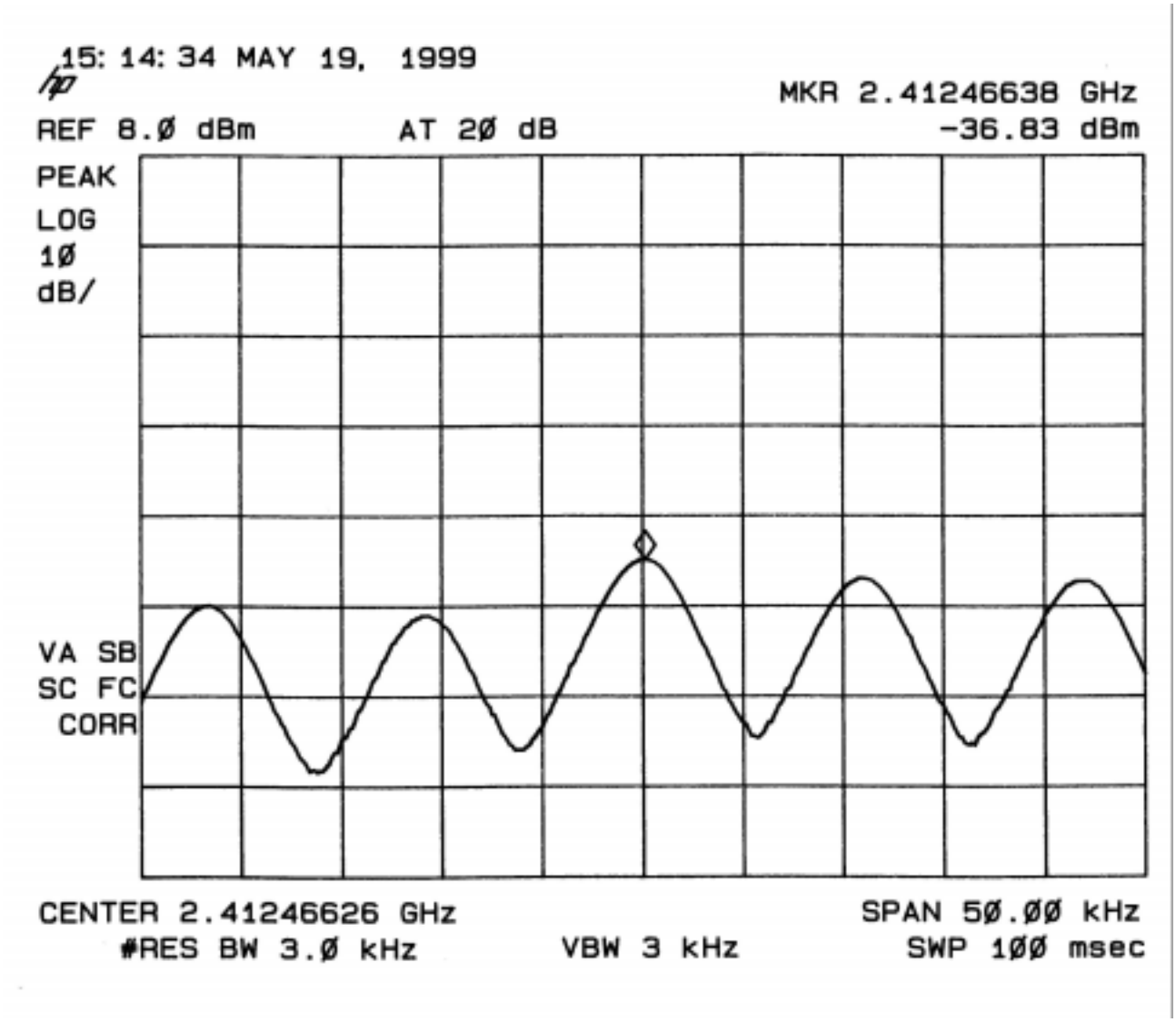
Tester signature : Date: June 17, 1999

Typed/Printed name : Jan S. Sikkema

11 Peak power density

The peak power measurement was performed in accordance with FCC 15.247 (d)

11.1 Channel 1



Plot 11.1: Peak Power Spectral Density plot of channel 1

Modulation = 5.5 Mbps

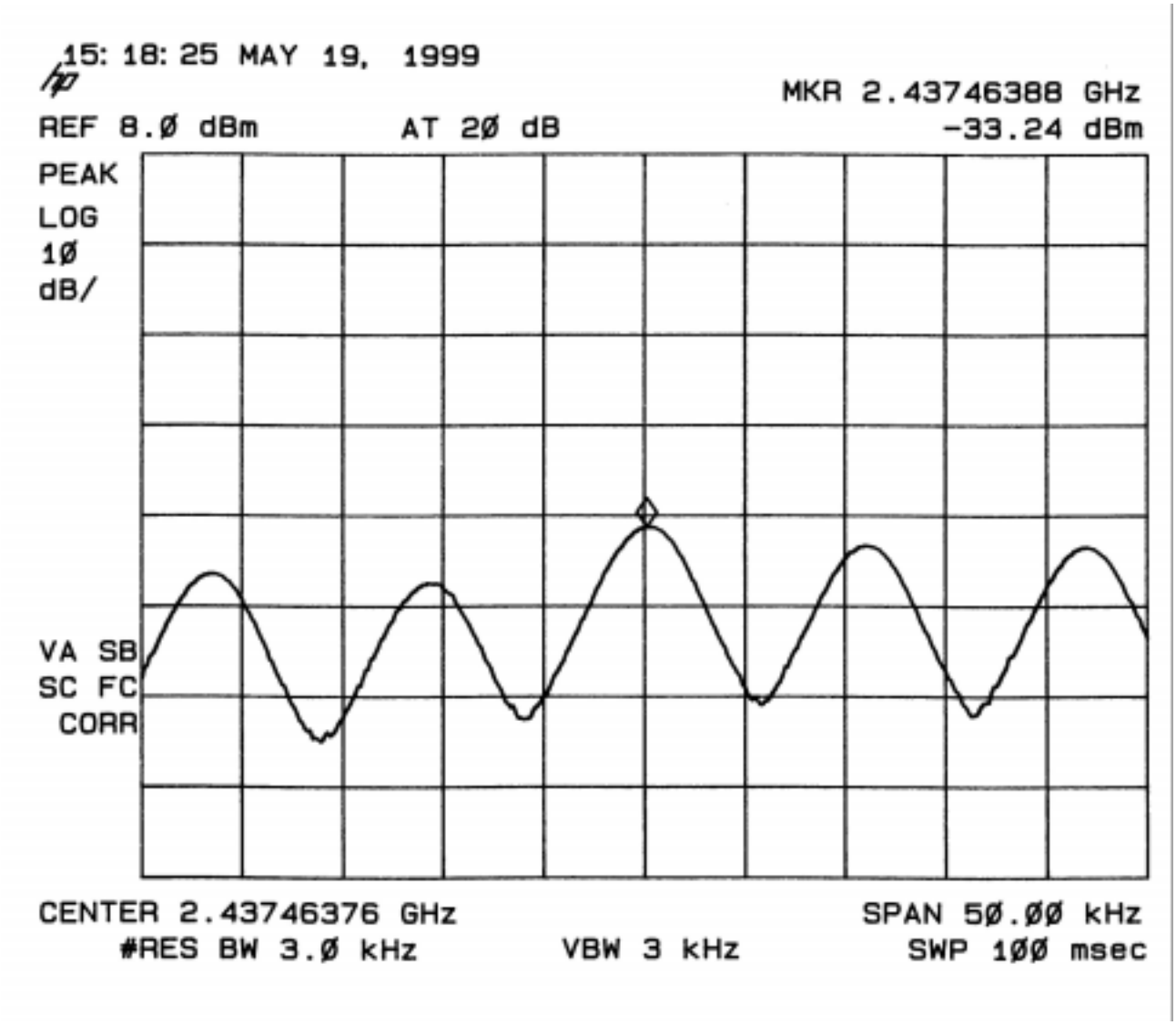
The peak power spectral density on channel 1 : -36.83 dBm.

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

11.2 Channel 6



Plot 11.2: Peak Power Spectral Density plot of channel 6

Modulation = 5.5 Mbps

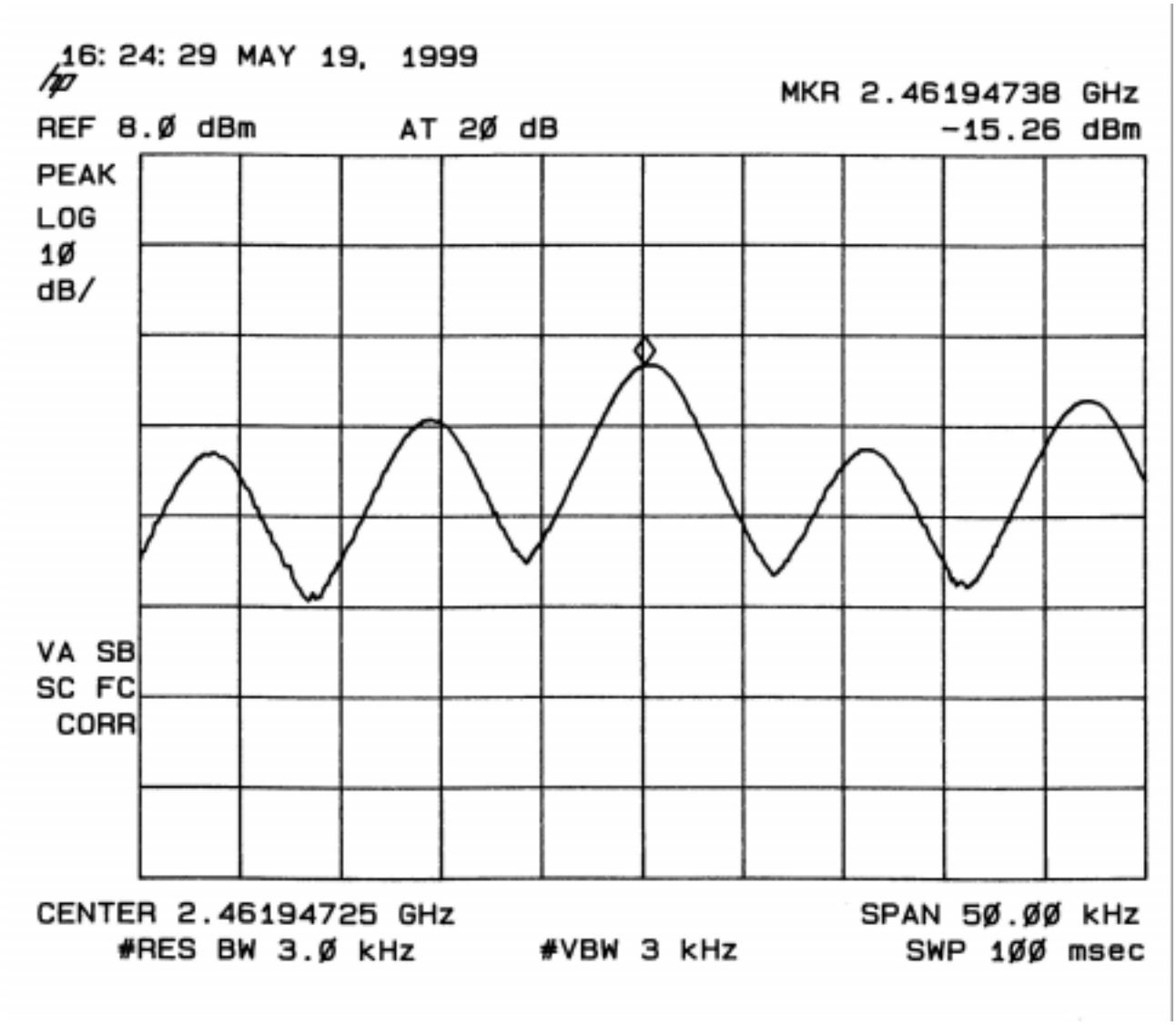
The peak power spectral density on channel 6 : -33.24 dBm.

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

11.3 Channel 11



Plot 11.3: Peak Power Spectral Density plot of channel 11

Modulation = 5.5 Mbps

The peak power spectral density on channel 11 : -15.26 dBm.

Test personnel:

Tester signature : Date: May 19, 1999

Typed/Printed name : Jan S. Sikkema

12 Processing gain

The processing gain is measured using the CW jamming margin method. A signal generator is stepped in 50 kHz increments across the passband of the system. At each point the generator level required to produce a Bit Error Rate equivalent to BER=1.0 x 10E-5 is recorded as the Jammer level (J). The output power of the transmitter is measured at the same point and recorded as Signal (S). The Jammer to Signal ratio (J/S) is then calculated with 20% of the worst datapoints discarded. The lowest remaining J/S ratio is used to calculate the processing gain using formula:

Gp = Es/No + Mj + Lsys

with:
Es/No = 18.7 dB for 11Mb/s (obtained from manufacturer's specification of spreading processor Harris semiconductor model HFA3860B)

Lsys = 2 dB

Measured lowest remaining J/S = Mj = -8.8 dB

Gp = 18.7 dB + (-8.8 dB) + 2 dB = 11.9 dB

12.1 Blockdiagram CW Jamming testsetup:

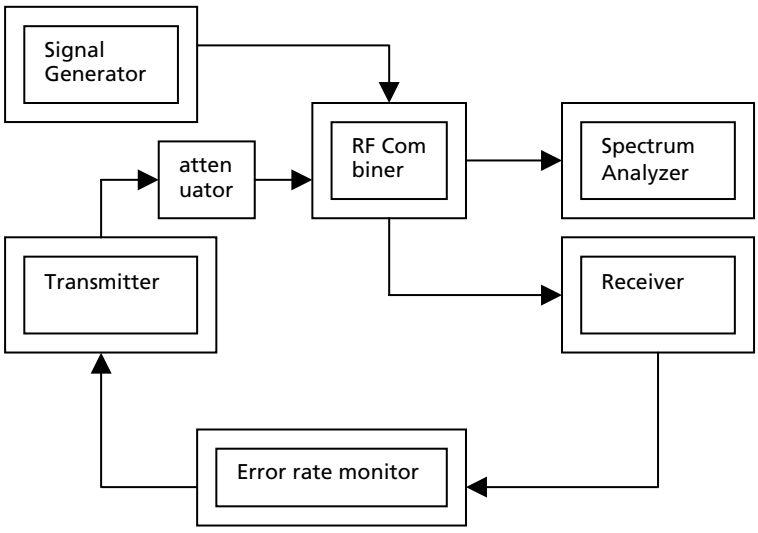


figure 12.1: blockdiagram of testsetup

12.2 Processing Gain testresults tables

pass band = fo ± 5MHz (5000 kHz = 100 x 50 kHz)
channel: 07 = 2441.7 MHz 1 of 4 (Parrot 1100 to Swallow 1100)

Frequency (MHz)	frequency offset (kHz)	J (dBm)	S (dBm)	J/S (dB)
2446.95	+100 x 50	-56.5	-51.0	-5.5
2446.90	+99 x 50	-56.6	-51.0	-5.6
2446.85	+98 x 50	-56.5	-51.0	-5.5
2446.80	+97 x 50	-56.6	-51.0	-5.6
2446.75	+96 x 50	-56.3	-51.0	-5.3
2446.70	+95 x 50	-56.0	-51.0	-5
2446.65	+94 x 50	-56.1	-51.0	-5.1
2446.60	+93 x 50	-56.2	-51.0	-5.2
2446.55	+92 x 50	-56.0	-51.0	-5
2446.50	+91 x 50	-55.7	-51.0	-4.7
2446.45	+90 x 50	-55.7	-51.0	-4.7
2446.40	+89 x 50	-55.8	-51.0	-4.8
2446.35	+88 x 50	-55.7	-51.0	-4.7
2446.30	+87 x 50	-55.9	-51.0	-4.9
2446.25	+86 x 50	-56.2	-51.0	-5.2
2446.15	+85 x 50	-56.9	-51.0	-5.9
2446.10	+84 x 50	-57.2	-51.0	-6.2
2446.05	+83 x 50	-57.6	-51.0	-6.6
2446.00	+82 x 50	-58.0	-51.0	-7
2445.95	+81 x 50	-58.4	-51.0	-7.4
2445.90	+80 x 50	-59.0	-51.0	-8
2445.85	+79 x 50	-59.0	-51.0	-8
2445.80	+78 x 50	-59.1	-51.0	-8.1
2445.75	+77 x 50	-59.4	-51.0	-8.4
2445.70	+76 x 50	-59.7	-51.0	-8.7
2445.65	+75 x 50	-60.1	-51.0	-9.1
2445.60	+74 x 50	-60.5	-51.0	-9.5
2445.55	+73 x 50	-60.1	-51.0	-9.1
2445.50	+72 x 50	-59.9	-51.0	-8.9
2445.45	+71 x 50	-59.9	-51.0	-8.9
2445.40	+70 x 50	-59.8	-51.0	-8.8
2445.35	+69 x 50	-59.9	-51.0	-8.9
2445.30	+68 x 50	-59.9	-51.0	-8.9
2445.25	+67 x 50	-60.0	-51.0	-9
2445.15	+66 x 50	-60.2	-51.0	-9.2
2445.10	+65 x 50	-60.3	-51.0	-9.3
2445.05	+64 x 50	-60.4	-51.0	-9.4
2445.00	+63 x 50	-60.3	-51.0	-9.3
2444.95	+62 x 50	-60.3	-51.0	-9.3
2444.90	+61 x 50	-60.4	-51.0	-9.4
2444.85	+60 x 50	-60.4	-51.0	-9.4
2444.80	+59 x 50	-60.1	-51.0	-9.1
2444.75	+58 x 50	-59.8	-51.0	-8.8
2444.70	+57 x 50	-59.8	-51.0	-8.8
2444.65	+56 x 50	-59.9	-51.0	-8.9
2444.60	+55 x 50	-59.6	-51.0	-8.6
2444.55	+54 x 50	-59.4	-51.0	-8.4
2444.50	+53 x 50	-59.0	-51.0	-8
2444.45	+52 x 50	-58.9	-51.0	-7.9
2444.40	+51 x 50	-58.5	-51.0	-7.5
2444.35	+50 x 50	-58.0	-51.0	-7

Table 12.1 : J/S values for fo(+50x50kHz) to fo(+100x50kHz)

pass band = fo ± 5MHz (5000 kHz = 100 x 50 kHz)
channel: 07 = 2441.7 MHz 2 of 4 (Parrot 1100 to Swallow 1100)

Frequency (MHz)	frequency offset (kHz)	J (dBm)	S (dBm)	J/S (dB)
2444.35	+50 x 50	-58.0	-51.0	-7
2444.30	+49 x 50	-58.1	-51.0	-7.1
2444.25	+48 x 50	-58.0	-51.0	-7
2444.15	+47 x 50	-57.8	-51.0	-6.8
2444.10	+46 x 50	-57.6	-51.0	-6.6
2444.05	+45 x 50	-57.5	-51.0	-6.5
2444.00	+44 x 50	-57.2	-51.0	-6.2
2443.95	+43 x 50	-57.3	-51.0	-6.3
2443.90	+42 x 50	-57.3	-51.0	-6.3
2443.85	+41 x 50	-57.8	-51.0	-6.8
2443.80	+40 x 50	-58.2	-51.0	-7.2
2443.75	+39 x 50	-58.3	-51.0	-7.3
2443.70	+38 x 50	-58.2	-51.0	-7.2
2443.65	+37 x 50	-58.3	-51.0	-7.3
2443.60	+36 x 50	-58.3	-51.0	-7.3
2443.55	+35 x 50	-58.2	-51.0	-7.2
2443.50	+34 x 50	-58.4	-51.0	-7.4
2443.45	+33 x 50	-58.9	-51.0	-7.9
2443.40	+32 x 50	-59.2	-51.0	-8.2
2443.35	+31 x 50	-58.4	-51.0	-7.4
2443.30	+30 x 50	-59.9	-51.0	-8.9
2443.25	+29 x 50	-60.0	-51.0	-9
2443.15	+28 x 50	-60.1	-51.0	-9.1
2443.10	+27 x 50	-60.1	-51.0	-9.1
2443.05	+26 x 50	-60.2	-51.0	-9.2
2443.00	+25 x 50	-60.2	-51.0	-9.2
2442.95	+24 x 50	-60.3	-51.0	-9.3
2442.90	+23 x 50	-60.5	-51.0	-9.5
2442.85	+22 x 50	-60.5	-51.0	-9.5
2442.80	+21 x 50	-60.6	-51.0	-9.6
2442.75	+20 x 50	-60.6	-51.0	-9.6
2442.70	+19 x 50	-60.4	-51.0	-9.4
2442.65	+18 x 50	-60.2	-51.0	-9.2
2442.60	+17 x 50	-60.1	-51.0	-9.1
2442.55	+16 x 50	-60.1	-51.0	-9.1
2442.50	+15 x 50	-60.2	-51.0	-9.2
2442.45	+14 x 50	-60.1	-51.0	-9.1
2442.40	+13 x 50	-59.9	-51.0	-8.9
2442.35	+12 x 50	-59.9	-51.0	-8.9
2442.30	+11 x 50	-59.8	-51.0	-8.8
2442.25	+10 x 50	-59.8	-51.0	-8.8
2442.15	+09 x 50	-59.9	-51.0	-8.9
2442.10	+08 x 50	-59.4	-51.0	-8.4
2442.05	+07 x 50	-59.0	-51.0	-8
2442.00	+06 x 50	-58.9	-51.0	-7.9
2441.95	+05 x 50	-58.9	-51.0	-7.9
2441.90	+04 x 50	-58.8	-51.0	-7.8
2441.85	+03 x 50	-59.0	-51.0	-8
2441.80	+02 x 50	-59.2	-51.0	-8.2
2441.75	+01 x 50	-59.3	-51.0	-8.3
2441.70	+00 x 50	-59.4	-51.0	-8.4

Table 12.2 : J/S values for fo(+0x50kHz) to fo(+50x50kHz)

pass band = fo ± 5MHz (5000 kHz = 100 x 50 kHz)
channel: 07 = 2441.7 MHz 3 of 4 (Parrot 1100 to Swallow 1100)

Frequency (MHz)	frequency offset (kHz)	J (dBm)	S (dBm)	J/S (dB)
2436.70	-100 x 50	-57.7	-51.0	-6.7
2436.75	-99 x 50	-57.2	-51.0	-6.2
2436.80	-98 x 50	-57.0	-51.0	-6
2436.85	-97 x 50	-56.8	-51.0	-5.8
2436.90	-96 x 50	-56.7	-51.0	-5.7
2436.95	-95 x 50	-56.3	-51.0	-5.3
2437.00	-94 x 50	-56.0	-51.0	-5
2437.05	-93 x 50	-55.7	-51.0	-4.7
2437.10	-92 x 50	-55.5	-51.0	-4.5
2437.15	-91 x 50	-55.4	-51.0	-4.4
2437.20	-90 x 50	-55.3	-51.0	-4.3
2437.25	-89 x 50	-55.8	-51.0	-4.8
2437.30	-88 x 50	-56.0	-51.0	-5
2437.35	-87 x 50	-56.1	-51.0	-5.1
2437.40	-86 x 50	-56.1	-51.0	-5.1
2437.45	-85 x 50	-56.1	-51.0	-5.1
2437.50	-84 x 50	-56.2	-51.0	-5.2
2437.55	-83 x 50	-56.8	-51.0	-5.8
2437.60	-82 x 50	-57.2	-51.0	-6.2
2437.65	-81 x 50	-57.6	-51.0	-6.6
2437.70	-80 x 50	-57.5	-51.0	-6.5
2437.75	-79 x 50	-57.6	-51.0	-6.6
2437.80	-78 x 50	-57.8	-51.0	-6.8
2437.85	-77 x 50	-57.9	-51.0	-6.9
2437.90	-76 x 50	-58.0	-51.0	-7
2437.95	-75 x 50	-58.1	-51.0	-7.1
2438.00	-74 x 50	-58.1	-51.0	-7.1
2438.05	-73 x 50	-58.0	-51.0	-7
2438.10	-72 x 50	-58.3	-51.0	-7.3
2438.15	-71 x 50	-58.7	-51.0	-7.7
2438.20	-70 x 50	-58.9	-51.0	-7.9
2438.25	-69 x 50	-58.8	-51.0	-7.8
2438.30	-68 x 50	-58.8	-51.0	-7.8
2438.35	-67 x 50	-58.9	-51.0	-7.9
2438.40	-66 x 50	-59.0	-51.0	-8
2438.45	-65 x 50	-58.6	-51.0	-7.6
2438.50	-64 x 50	-58.4	-51.0	-7.4
2438.55	-63 x 50	-58.5	-51.0	-7.5
2438.60	-62 x 50	-58.5	-51.0	-7.5
2438.65	-61 x 50	-58.2	-51.0	-7.2
2438.70	-60 x 50	-57.8	-51.0	-6.8
2438.75	-59 x 50	-57.7	-51.0	-6.7
2438.80	-58 x 50	-57.7	-51.0	-6.7
2438.85	-57 x 50	-57.6	-51.0	-6.6
2438.90	-56 x 50	-57.5	-51.0	-6.5
2438.95	-55 x 50	-57.4	-51.0	-6.4
2439.00	-54 x 50	-57.4	-51.0	-6.4
2439.05	-53 x 50	-57.7	-51.0	-6.7
2439.10	-52 x 50	-58.3	-51.0	-7.3
2439.15	-51 x 50	-58.3	-51.0	-7.3
2439.20	-50 x 50	-58.2	-51.0	-7.2

Table 12.3 : J/S values for fo(-50x50kHz) to fo(-100x50kHz)

pass band = fo ± 5MHz (5000 kHz = 100 x 50 kHz)
channel: 07 = 2441.7 MHz 4 of 4 (Parrot 1100 to Swallow 1100)

Frequency (MHz)	frequency offset (kHz)	J (dBm)	S (dBm)	J/S (dB)
2439.20	-50 x 50	-58.2	-51.0	-7.2
2439.25	-49 x 50	-58.0	-51.0	-7
2439.30	-48 x 50	-57.9	-51.0	-6.9
2439.35	-47 x 50	-57.5	-51.0	-6.5
2439.40	-46 x 50	-57.2	-51.0	-6.2
2439.45	-45 x 50	-57.2	-51.0	-6.2
2439.50	-44 x 50	-57.0	-51.0	-6
2439.55	-43 x 50	-57.0	-51.0	-6
2439.60	-42 x 50	-56.9	-51.0	-5.9
2439.65	-41 x 50	-57.0	-51.0	-6
2439.70	-40 x 50	-57.2	-51.0	-6.2
2439.75	-39 x 50	-57.3	-51.0	-6.3
2439.80	-38 x 50	-57.2	-51.0	-6.2
2439.85	-37 x 50	-57.4	-51.0	-6.4
2439.90	-36 x 50	-57.8	-51.0	-6.8
2439.95	-35 x 50	-58.0	-51.0	-7
2440.00	-34 x 50	-57.9	-51.0	-6.9
2440.05	-33 x 50	-57.8	-51.0	-6.8
2440.10	-32 x 50	-57.8	-51.0	-6.8
2440.15	-31 x 50	-58.0	-51.0	-7
2440.20	-30 x 50	-58.4	-51.0	-7.4
2440.25	-29 x 50	-58.8	-51.0	-7.8
2440.30	-28 x 50	-58.6	-51.0	-7.6
2440.35	-27 x 50	-58.6	-51.0	-7.6
2440.40	-26 x 50	-58.4	-51.0	-7.4
2440.45	-25 x 50	-58.3	-51.0	-7.3
2440.50	-24 x 50	-58.4	-51.0	-7.4
2440.55	-23 x 50	-58.4	-51.0	-7.4
2440.60	-22 x 50	-58.5	-51.0	-7.5
2440.65	-21 x 50	-58.5	-51.0	-7.5
2440.70	-20 x 50	-58.6	-51.0	-7.6
2440.75	-19 x 50	-59.0	-51.0	-8
2440.80	-18 x 50	-59.3	-51.0	-8.3
2440.85	-17 x 50	-59.3	-51.0	-8.3
2440.90	-16 x 50	-59.4	-51.0	-8.4
2440.95	-15 x 50	-59.3	-51.0	-8.3
2441.00	-14 x 50	-59.3	-51.0	-8.3
2441.05	-13 x 50	-59.2	-51.0	-8.2
2441.10	-12 x 50	-59.2	-51.0	-8.2
2441.15	-11 x 50	-59.2	-51.0	-8.2
2441.20	-10 x 50	-59.4	-51.0	-8.4
2441.25	-09 x 50	-59.8	-51.0	-8.8
2441.30	-08 x 50	-60.2	-51.0	-9.2
2441.35	-07 x 50	-59.8	-51.0	-8.8
2441.40	-06 x 50	-59.4	-51.0	-8.4
2441.45	-05 x 50	-59.4	-51.0	-8.4
2441.50	-04 x 50	-59.5	-51.0	-8.5
2441.55	-03 x 50	-59.3	-51.0	-8.3
2441.60	-02 x 50	-59.2	-51.0	-8.2
2441.65	-01 x 50	-59.3	-51.0	-8.3
2441.70	-00 x 50	-59.3	-51.0	-8.3

Table 12.4 : J/S values for fo(-0x50kHz) to fo(-50x50kHz)

12.3 Summary of J/S values

J/S table 1	J/S table 2	J/S table 3	J/S table 4
-9.5	**-9.6**	-8	**-9.2**
-9.4	**-9.6**	-7.9	**-8.8**
-9.4	**-9.5**	-7.9	**-8.8**
-9.4	**-9.5**	-7.8	-8.5
-9.3	**-9.4**	-7.8	-8.4
-9.3	**-9.3**	-7.7	-8.4
-9.3	**-9.2**	-7.6	-8.4
-9.2	**-9.2**	-7.5	-8.4
-9.1	**-9.2**	-7.5	-8.3
-9.1	**-9.2**	-7.4	-8.3
-9.1	**-9.1**	-7.3	-8.3
-9	**-9.1**	-7.3	-8.3
-8.9	**-9.1**	-7.3	-8.3
-8.9	**-9.1**	-7.2	-8.3
-8.9	**-9.1**	-7.2	-8.3
-8.9	**-9**	-7.1	-8.2
-8.9	**-8.9**	-7.1	-8.2
J/S = -8.8	**-8.9**	-7	-8.2
-8.8	**-8.9**	-7	-8.2
-8.8	**-8.9**	-6.9	-8
-8.7	-8.8	-6.8	-7.8
-8.6	-8.8	-6.8	-7.6
-8.4	-8.4	-6.7	-7.6
-8.4	-8.4	-6.7	-7.6
-8.1	-8.3	-6.7	-7.5
-8	-8.2	-6.7	-7.5
-8	-8.2	-6.6	-7.4
-8	-8	-6.6	-7.4
-7.9	-8	-6.6	-7.4
-7.5	-7.9	-6.5	-7.4
-7.4	-7.9	-6.5	-7.3
-7	-7.9	-6.4	-7.2
-7	-7.8	-6.4	-7
-6.6	-7.4	-6.2	-7
-6.2	-7.4	-6.2	-7
-5.9	-7.3	-6	-6.9
-5.6	-7.3	-5.8	-6.9
-5.6	-7.3	-5.8	-6.8
-5.5	-7.2	-5.7	-6.8
-5.5	-7.2	-5.3	-6.8
-5.3	-7.2	-5.2	-6.5
-5.2	-7.1	-5.1	-6.4
-5.2	-7	-5.1	-6.3
-5.1	-7	-5.1	-6.2
-5	-6.8	-5	-6.2
-5	-6.8	-5	-6.2
-4.9	-6.6	-4.8	-6.2
-4.8	-6.5	-4.7	-6
-4.7	-6.3	-4.5	-6
-4.7	-6.3	-4.4	-6
-4.7	-6.2	-4.3	-5.9

Table 12.5: J/S values sorted in descending order

Note: Values in bold font are 20% worst case discarded. J/S = *-8.8* (italics)

12.4 Photograph of testsetup

Photograph 12.1: testsetup