Test Report for
FibeAir 1500™

LMDS Band A Point-to-Point Radio

To: FCC part 101

This test report is issued under the authority of Inon Beracha
Vice President of R&D:

Written By:	Checked By:
Report Copy No: 1	Issue Date: 13 April, 2000

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1. Technical Summary

Manufacturer:	**GIGANET Ltd.** **8 Hanechoshet St.** **Tel Aviv** **Israel 69710**	
FCC ID	NZ4GNT-FA1500-28	
Number of units tested:	One	
Equipment Category:	Digital Microwave Fixed link	
Trade Name Of Equipment:	FibeAir-1500	
Manufacturer Type Designation:	28-4A or 28-4B	
Type of Equipment:	Transceiver	
Data Rate(s):	155 Mbit/s	
Type of Modulation:	16 QAM	
Type of Emission:	50M0D7W	
Occupied Bandwidth (Inband: 99%,Outband:+0.5%,-0.5%):	48 MHz	
Rated Output Power (dBm):	20.0	
Frequency Range (MHz)	Transmit:	27500 to 27650
	Receive:	27990 to 28140
Duplex Distance (MHz)	490	
Channel Spacing (MHz)	50	
Frequency Tolerance (%):	±0.0005	
Voltage	-40.5V to –57V DC @ 3A	
Extreme Test Temperature Range (°C)	Outdoor Unit:	-35 to +55
	Indoor Unit:	-5 to +45

2. Tests Required

The following tests are required:

Test Name	CFR47 Part2 Section:	CFR47 Part101 Section:
RF Power output	2.1046(a)	101.113(a)
Modulation Characteristics (spectrum Mask)	2.1047(d)	101.111(a)(2)(ii)
Occupied Bandwidth	2.1049(h)	101.109
Spurious emissions at antenna terminals	2.1051	101.111(a)(2)(iii)
Field strength of spurious radiation	2.1053	101.111(a)(2)(iii)
Frequency Stability	2.1055	101.107

3. Measurements, Examinations and Derived Results

3.1. General Comments

This section contains the test results only. Details of the test metohd used have been recorded and are kept on file by the laboratory. Wherever possible the test methods described in ANSI C63.4 (1992) and its applicable documents have been used.

The measurement uncertainties stated were calculated with confidence level of 95%.

The purpose of the tests was to demonstrate compliance with the test specification.

Measurements were performed between the following dates:

Start Date: 2-April -2000 Finish Date: 13-April-2000

All the measurements described in this report were performed at the premises of Giganet Ltd., 8 Hanechoshet St. Tel-Aviv Israel 69710 and HERMON LABORATORIES Binyamina 30550, Israel.

The extremes of test voltage were taken as -40 V and -57.0 V (negative sense)

Unless otherwise specified, measurements were performed on the mid channel which represents the behavior over the entire frequency band.

3.1.1.Test Results

3.1.2.RF Power output

Test Conditions		**Transmitter Power (dBm)**
Tnom. 25.0 °C	Vnom (-48V)	20.0(1)
Measurement Uncertainty (dB)		±0.5
Tolerance on declared Rated power, All Test Conditions (dB)		±1.0

Limits	**EIRP**	**Power at Antenna Terminal (2)**
101.113(a)	55dBw (85dBm)	43.5dBm

(1) All the following tests have been performed at this output power, which presents the worst case conditions.

(2) Maximum Antenna Gain is 41.5dBi (See data sheet), therefore, the equivalent limit on output power ($Pout_{max}$) at antenna terminals:

$$Pout_{max} = EIRP - Antenna\ Gain = 85 - 41.5 = \underline{43.5\ dBm}$$

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 4)
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables

3.1.3.RF spectrum Mask

Test Conditions		Mid. Channel	Test Results
Tnom. 25.0°C	Vnom (-48V)	27575 MHz (Low)	Graph 6-1
		28065 MHz (High)	Graph 6-2

Limits	Notes
101.111(a)(2)ii	Mask limits are plotted on the Test Results graphs

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 4)
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables

3.1.4. Occupied Bandwidth

Test Conditions		**Mid. Channel**	**Test Results**
Tnom. 25.0 °C	Vnom (-48V)	27575 MHz (Low)	45.0MHz (Graph 6-3)
		28065 MHz (High)	45.0MHz (Figure 6-4)

Limits	**Notes**
101.109, 101.147	850MHz(Maximum authorized bandwidth). A more stringent value of 48MHz is specified for the system due to the **efficient 16QAM modulation.** 2. Occupied Bandwidth is defined according to 2.1049 (0.5% on each side of the BW) and the test conditions as specified in 2.1049(h)

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 521)
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables

3.1.5.Spurious emissions at antenna terminals

Ambient Temperature: 25.0 °C Supply Voltage: -48V

Limit	Test Results
101.111(a)(2)(iii): -13dBm at 1MHz resolution	The output spectrum was verified from 9Khz to 100 GHz. **No spurious greater then –33dbm was measured**. (1)

(1) Spurious were not recorded because all the spurious signals are more than **20 dB below the –13dBm limit.**

(2) The spurious limit of –13dBm outside the 250% BW is based on 101.111(a)(2)(iii). (The spurious within 250% are measured in the Modulation characteristics).

> A = 43 + Log(Mean Output Power in Watts)
>
> Mean Output Power = 20dBm (-10dBW)
>
> A = 43 – 10 = 33
>
> Spurious_{dBm} = Mean Output Power – A = 20 – 33 = -13dBm

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 4, 25,521) and Millimeter wave mixers (No. 747, 747, 1265).
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables

3.1.6.Field strength of spurious radiation

Ambient Temperature: 25.0 °C Supply Voltage: -48V

Limit	Test Method
101.111(a)(2)(iii): -13dBm at 1MHz resolution at antenna terminals.	The output spectrum was verified from 9Khz to100GHz [1] The radiated spurious signals field strength was measured in dBuV/m at 3 meters. The limit of -13dBm at antenna's terminal was translated to dBuV/m at a distance of 3 meters.

$$E\left(\frac{V}{meter}\right)=\sqrt{\frac{30\cdot Pt\cdot Gt}{R^2}}$$

$$E_{dB}\left(\frac{\mu V}{meter}\right)=10\cdot\log(30)-13-30+2.1-10\cdot\log(9)+120=84.3$$

The limit in dBuV/m was calculated assuming a half wavelength dipole antenna (Gt = 2.1 dBi) radiating a spurious input power of Pt= –13dbm at it input. The field strength at R=3 meters can be calculated:

Test Results:

Spurious Frequency	Measured Spurious Level dBµv/m	Limit dBµv/m	Spurious referred to Antenna's terminals (dBm)	Spurious referred to Antenna's terminals in dBc with reference to output power
20.324 GHz	71.8	84.3	-25.53	45.53
20.648 GHz	72.0	84.3	-25.33	45.33
28.599 GHz	75.2	84.3	-22.13	42.13
26.814 GHz	74.5	84.3	-22.83	42.83
54.920 GHz	77.9	84.3	-19.43	39.43
55.280 GHZ	78.0	84.3	-19.33	39.33
62.960 GHZ	71.3	84.3	-26.03	46.03
63.870 GHZ	71.6	84.3	-25.73	45.73
91.010 GHZ	77.9	84.3	-19.43	39.43

Note: It is suspected that the **above spurious signals are not real** and are the result of the **Millimiter wave external harmonic mixer** (those spurious signals remained at the same level when the system under test DC voltages were turned off. To be on the safe side, we have decided to include them in the measurements.

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 4, 25,521) and Millimeter wave mixers: (No. 747, 747, 1265).
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables
6. Antenna (No. 39, 41, 604, 768, 769, 770, 771, 772)

3.1.7.FREQUENCY STABILITY

Limit	Test Method
101.107: +/- 0.001% (+/-10PPM)	Per 2.1055

Test Conditions	Frequency Error (ppm)		
	-40V	**-48V**	**-57V**
50 C^o	-0.35	-0.35	-0.35
40 C^o	0.12	0.12	0.12
30 C^o	0.09	0.09	0.09
20 C^o	0.25	0.25	0.25
10 C^o	0.1	0.1	0.1
0 C^o	0.07	0.07	0.07
-10 C^o	-0.1	-0.1	-0.1
-20 C^o	-0.4	-0.4	-0.4
-30 C^o	-0.55	-0.55	-0.55
Maximum Frequency Error (ppm)	0.55		
Measurement Uncertainty (ppm)	±0.26		

Test Equipment used (No. # refer to Para. 5 equipment list):

1. Spectrum Analyzer (No. 4, 25,521) and Millimeter wave mixers: (No. 747, 747, 1265).
2. Power Meter (No. 1)
3. SDH Analyzer (No. 0)
4. Power Supply (No. 14)
5. Attenuators, adapters and Cables

4. Summary Of Test Results

The summary of the test results is given as follows:

Test	Pass/Fail
RF Power output	Pass
RF spectrum Mask	Pass
Occupied Bandwidth	Pass
Spurious emissions at antenna terminals	Pass
Field strength of spurious radiation	Pass
Frequency Stability	Pass

Pass = Complied with the requirements of the specification for this test.

Fail = Did not comply with the requirements of the specification for this test.

U = The results were within measurement uncertainties hence any decision regarding compliance will be made by the enforcing agency.

N/A = Not Applicable.

5. Test Equipment Used

The following tables describe the test equipment used throughout the testing procedures.

No.	Instrument	Maker	Type No.	Serial No.
0.	S.D.H Analyzer	H.P	HP37717C	GB00002508
1.	Power Meter	Anritsu	ML2438A	98360020
2.	Power Sensor	Anritsu	MA2474A	982155
3.	W.G to Coax	MDL	42AC206	N/A
4.	Spectrum Analyzer 50G	H.P	8565E	3846A011229
5.	RF Cable	Insulated Wire	Kps1533787kps	N/A
6.	W.G Bend	Dorado Int.	BE-42	9415
7.	W.G Bend	Dorado Int.	BE-42	9416
8.	W.G Variable Attenuator	Dorado Int.	VA-42	9404
9.	W.G Variable Attenuator	Dorado Int.	VA-42	9412
10.	W.G Directional Coupler	Dorado Int.	DCG-42-10C	9501-B
11.	W.G Fixed Attenuator	Dorado Int.	FA-42-20	9403
12.	W.G Extender	Dorado Int.	S-42-F	98010
13.	W.G Extender	Dorado Int.	S-42-F	98011
14.	DC Power Supply	Horizon	DHR3655D	767462
15.	Plotter (Think Jet)	H.P	2225A	2640S30223
16.	Precision Rotary Attenuator	FMI	20110	1003
25.	Spectrum Analyzer 23/140G	Anritsu	MS-710C	5837
39.	Antenna, Remote, Active Loop, 9kHz-30MHz	Electro - Metrics	ALR 30	123
41.	Antenna, Double Ridged Guide (horn), 1-18GHz	Electro - Metrics	RGA 50/60	2811
275.	Table Non Metallic, adjustable height	HL	TNM	040
287.	Turntable, Motorized Diameter, 2m	HL	TMD-2	042
413.	Cable, Coax, Microwave, DC-18G TNC-TNC, 4m	Gore	R3C01C0116	N/A
465.	Anechoic Chamber 9(L) x 5.5(H) m	HL	AC-1	023
521.	Spectrum Analyzer with RF filter section-HP EMI	HP	8546A	3617A00319
593.	Antenna, Mast, 1-4/1-6 m Pneumatic	HL	AM-F1	101
594.	Turn Table FOR ANECHOIC CHAMBER flush mount	HL	TT-WDC1	102
604.	Antenna, BiconiLog Log Periodic/T Bow TIE 26-	Emco	3141	9611-1011

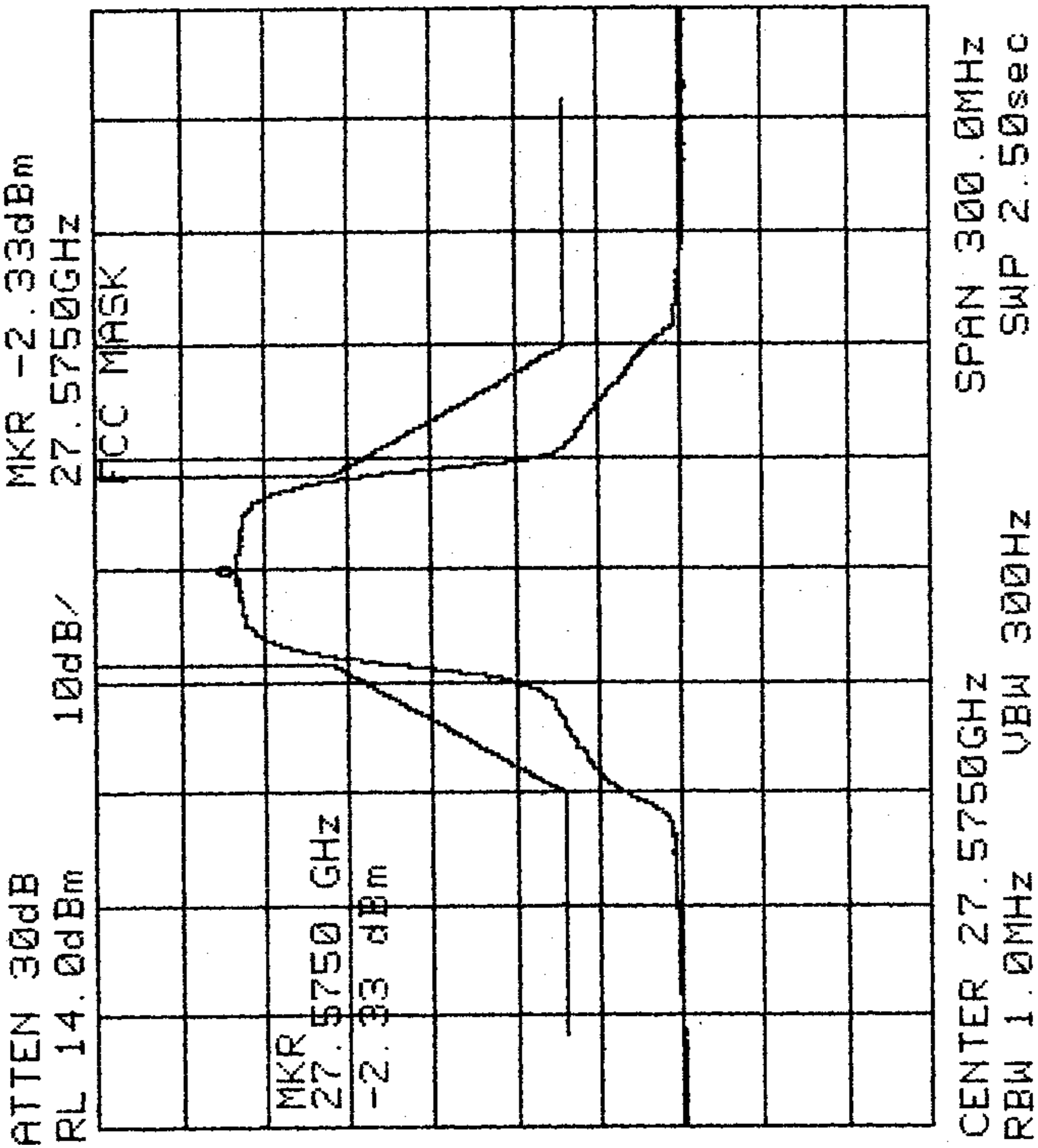
	2000MHz			
747.	Mixer Millimeter Wave Harmonic 90-140GHz	Oleson Microwave	M08HW	F80429-1
748.	Mixer Millimeter Wave Harmonic 60-90GHz	Oleson Microwave	M12HW	E80429-1
749.	Mixer General Purpose waveguide 26.5-40GHz	Tektronix	119-0099-01	N/A
750.	Mixer General Purpose waveguide 18-26GHz	Tektronix	119-0098-01	N/A
768.	Antenna, Standard Gain Horn, 26.5GHz WR-42, K-	Quinstar Technology	QWH-4200-	110
769.	Antenna, Standard Gain Horn, 26.5-40GHz WR-28, Ka-	Quinstar Technology	QWH-2800-	112
770.	Antenna, Standard Gain Horn, 40-60GHz U-band	Quinstar Technology	QWH-1900-	118
771.	Antenna, Standard Gain Horn, 60-90GHz WR-12, Gain-	Quinstar Technology	QWH-1200-	111
772.	Antenna, Standard Gain Horn, 90-140GHz WR-8, Gain-	Quinstar Technology	QWH-0800-	110
1059.	Cable, Coaxial, Microwave DC-18GHz, TNC-TNC, 6m	Gore	GXCO1CO12	8846001
1201.	Cable, Coax, 40M-40GHz	Insolated Wire	KPS-	04431999
1265.	Waveguide mixer 40 to 60GHz	Tektronix	WM 490U	B010629

6. Graphs

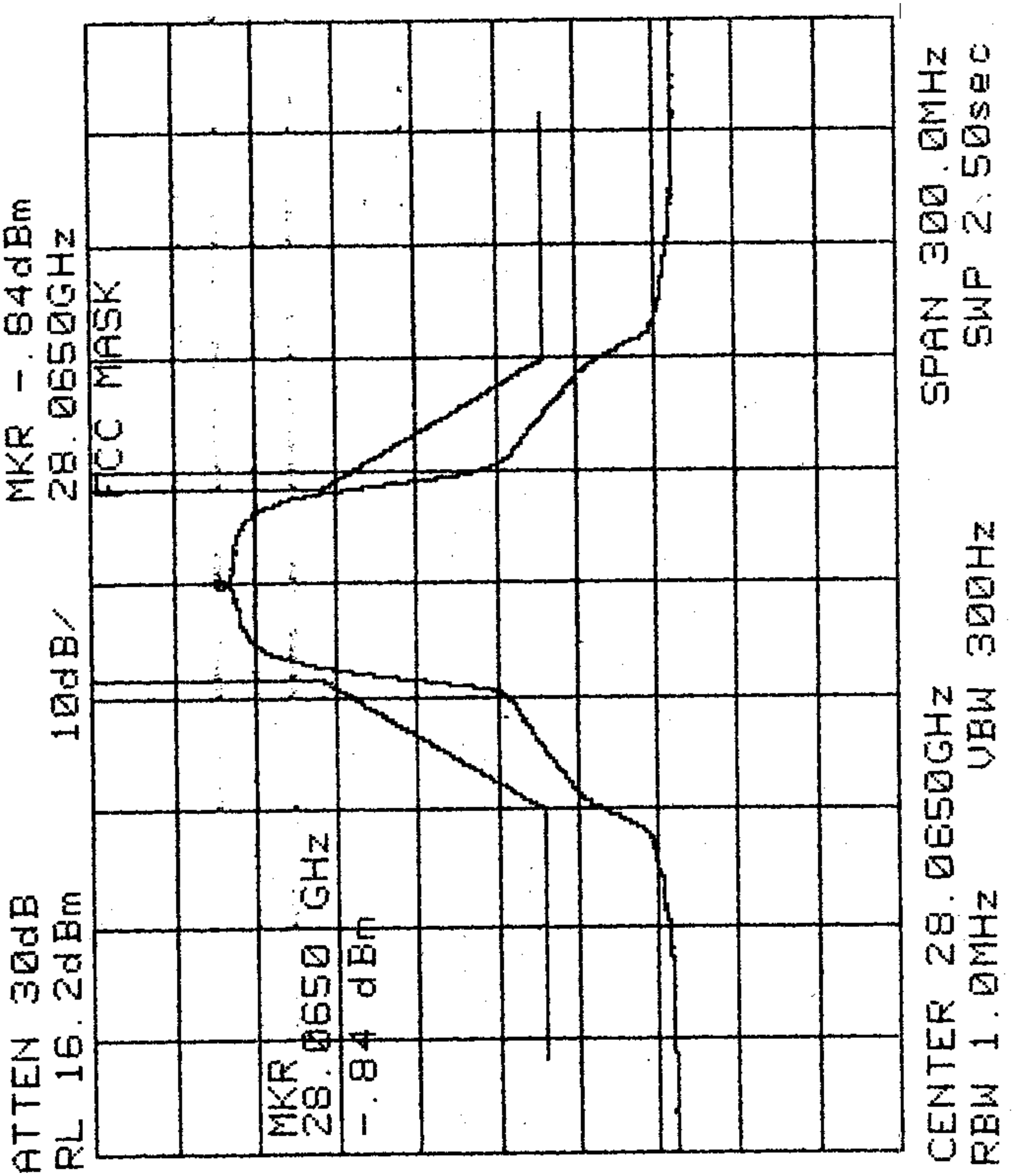
This section includes graphical representation of major system tests. The following table lists the graphs included with this report.

Spectrum Mask: ±250MHz	Low channel	Fig. 6-1
Spectrum Mask: ±250MHz	High channel	Fig. 6-2
Occupied Bandwidth	Low channel	Fig. 6-3
Occupied Bandwidth	High channel	Fig. 6-4
Radiated spurious emissions	Low/High channels	Fig. 6-5
Radiated spurious emissions	Low/High channels	Fig. 6-6
Radiated spurious emissions	Low/High channels	Fig. 6-7
Radiated spurious emissions	Low/High channels	Fig. 6-8
Radiated spurious emissions	Low/High channels	Fig. 6-9
Radiated spurious emissions	Low/High channels	Fig. 6-10
Radiated spurious emissions	Low/High channels	Fig. 6-11
Radiated spurious emissions	Low/High channels	Fig. 6-12
Radiated spurious emissions	Low/High channels	Fig. 6-13

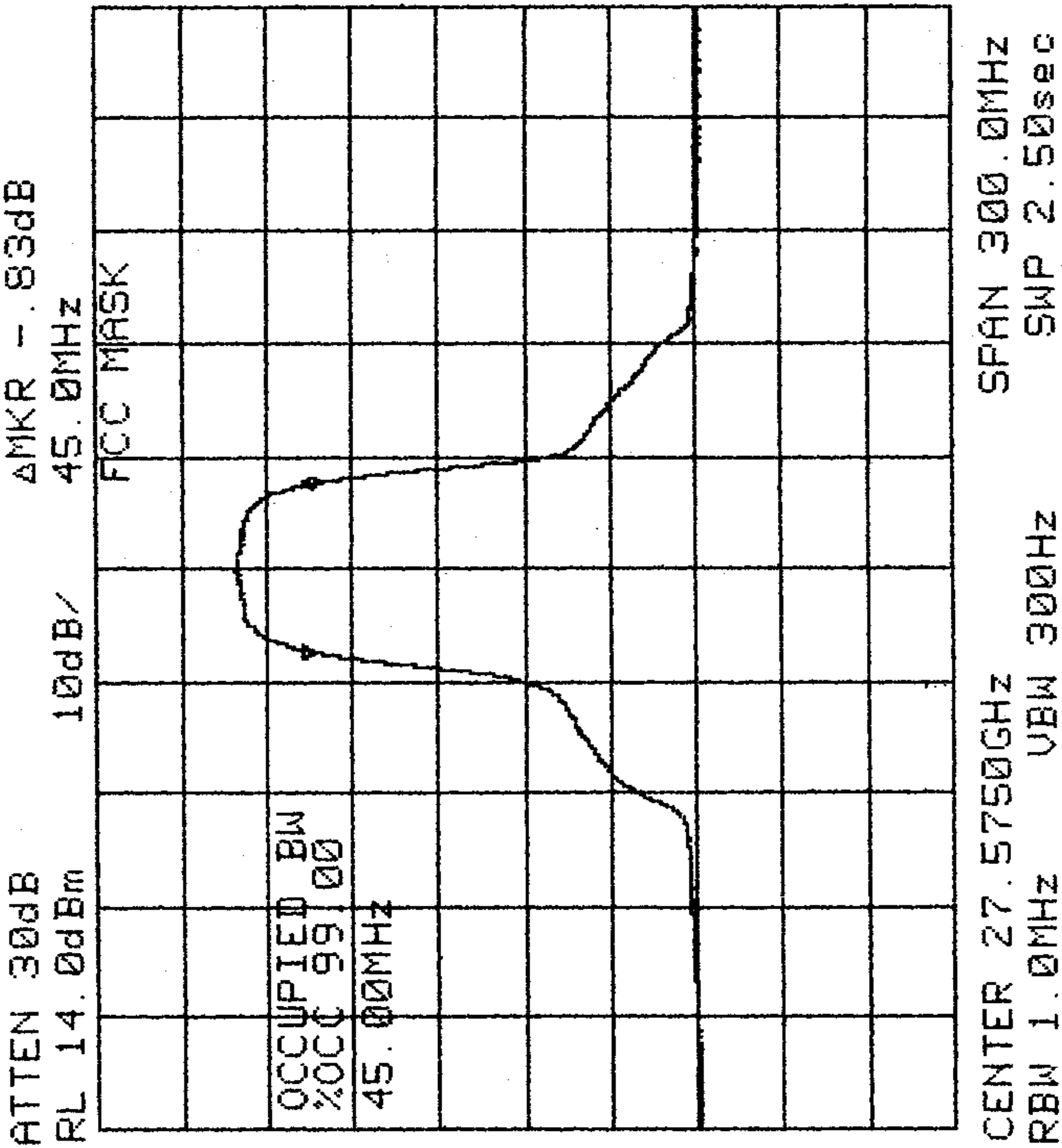
Graph 6-1: Spectrum Mask – Low Channel



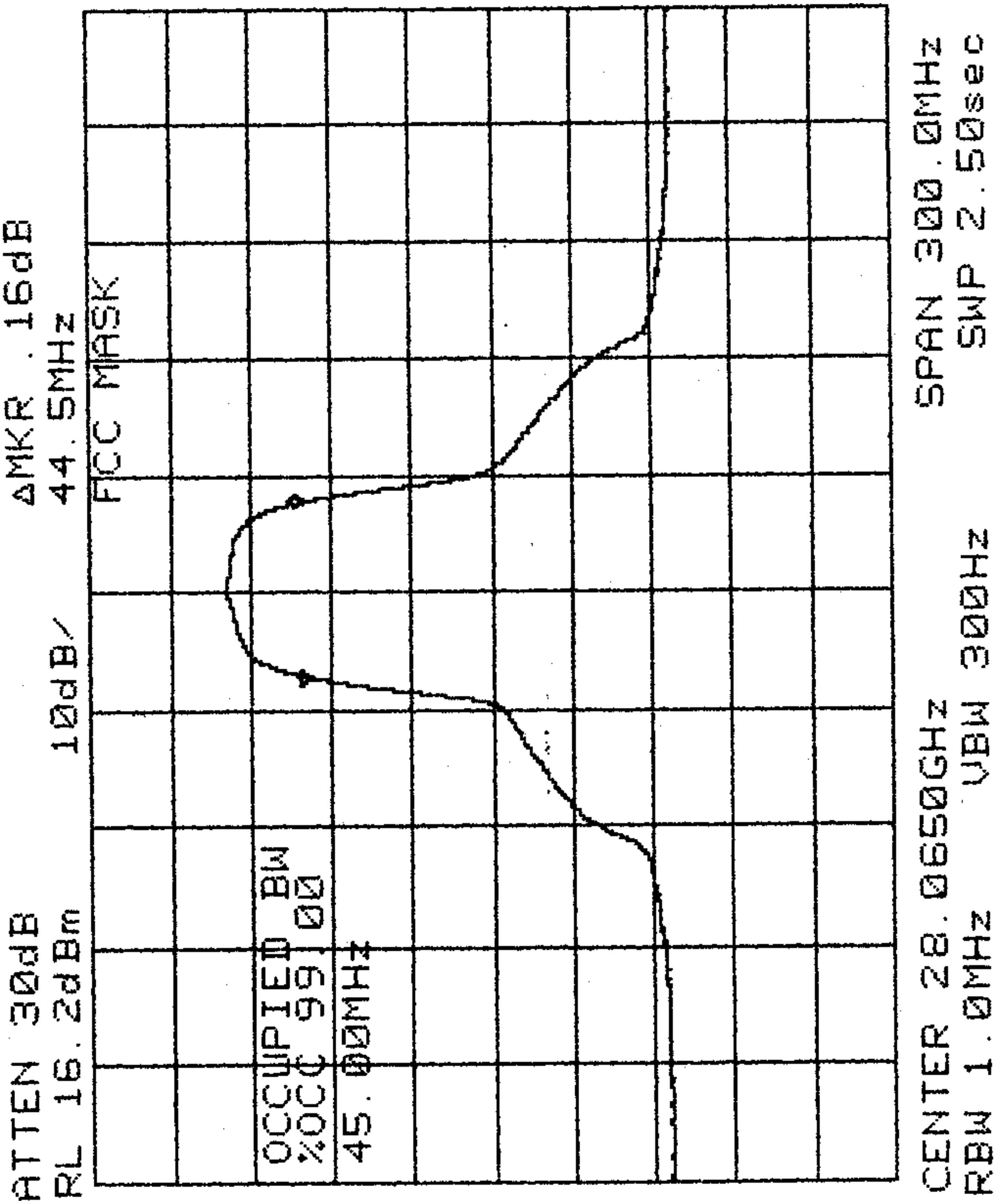
Graph 6-2: Spectrum Mask – High Channel



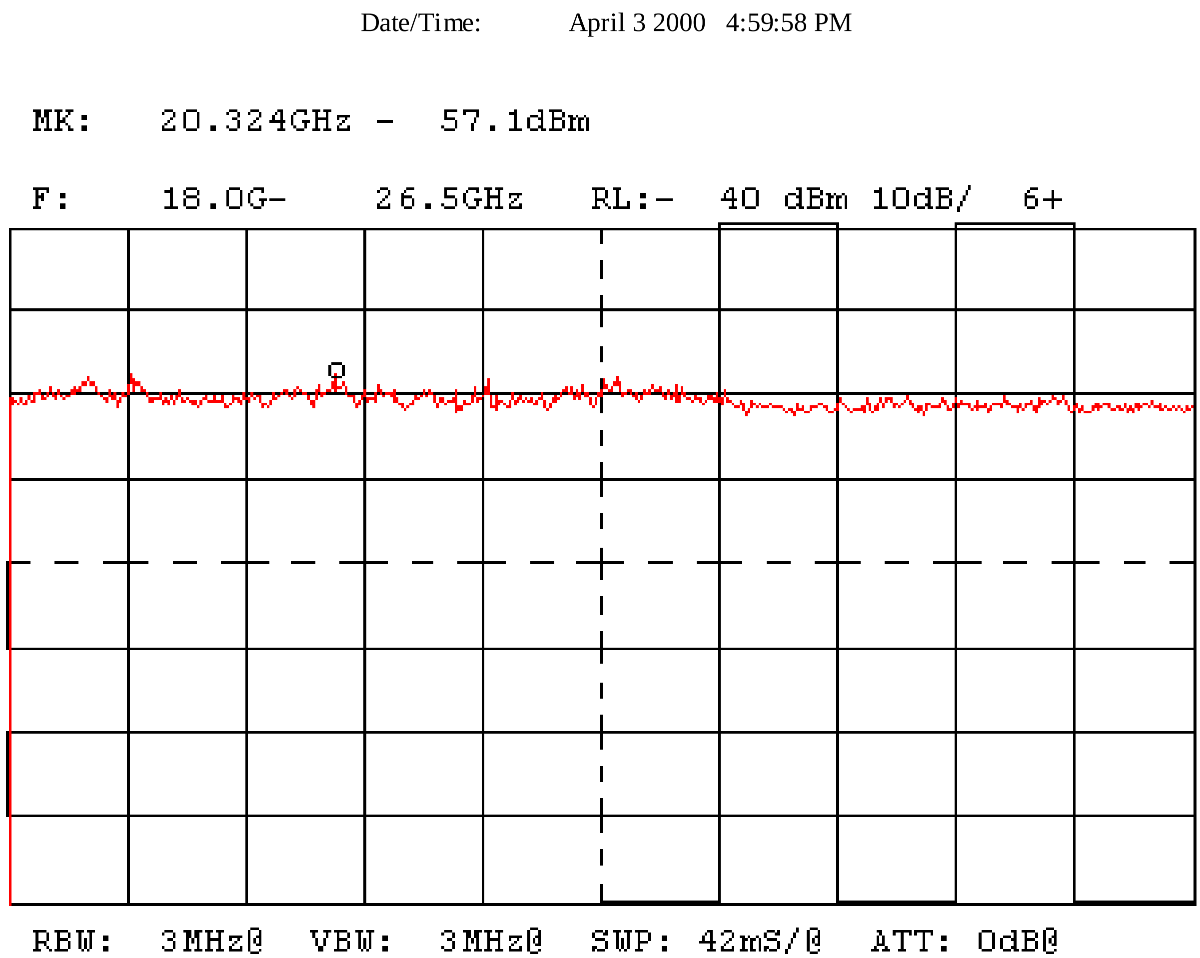
Graph 6-3: Occupied bandwidth – Low Channel



Graph 6-4: Occupied bandwidth – High Channel



Graph 6-5: Field Strength of spurious radiation



Horizontal polarization
Antenna factor=31.4 dB
Field strength=-57.1 dBm+107+31.4 –9.5 = 71.8 dBuV/m

Graph 6-6: Field Strength of spurious radiation

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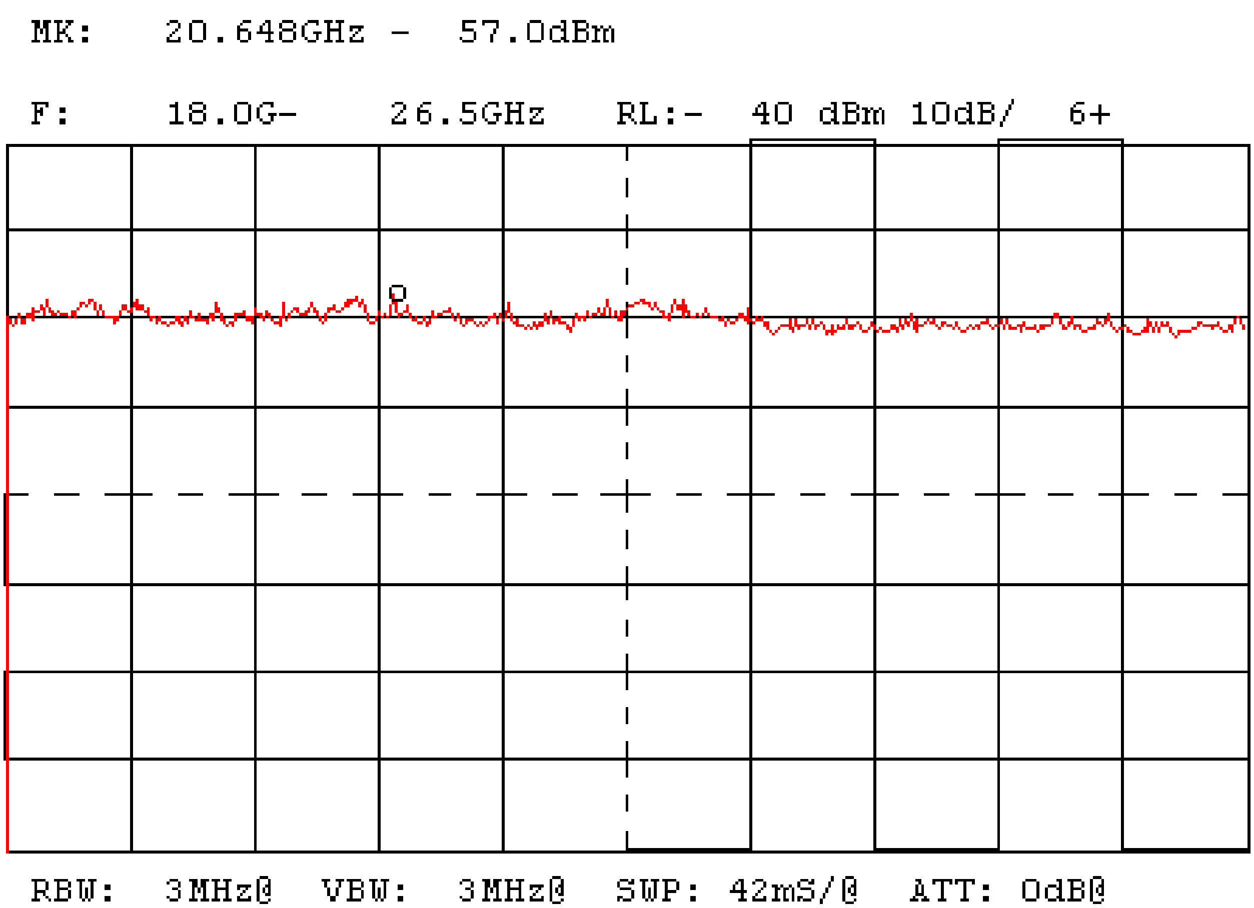

Vertical polarization
Antenna factor=31.5 dB
Field strength=-57 dBm+107+31.5 –9.5 =72 dBuV/m

Graph 6-7: Field Strength of spurious radiation

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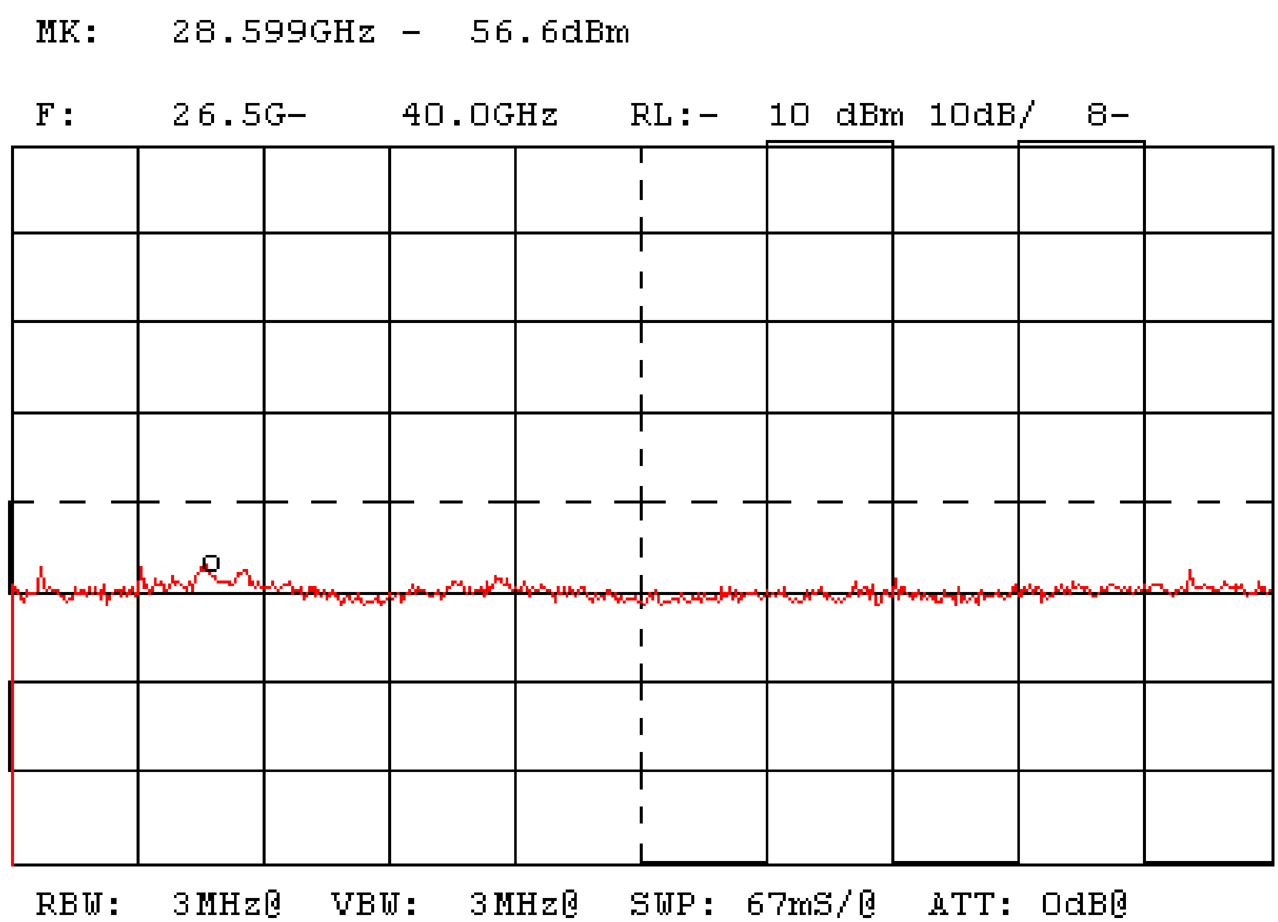

Vertical polarization
Antenna factor=34.3 dB
Field strength=-56.6 dBm+107+34.3 –9.5 = 75.2 dBuV/m

Graph 6-8: Field Strength of spurious radiation

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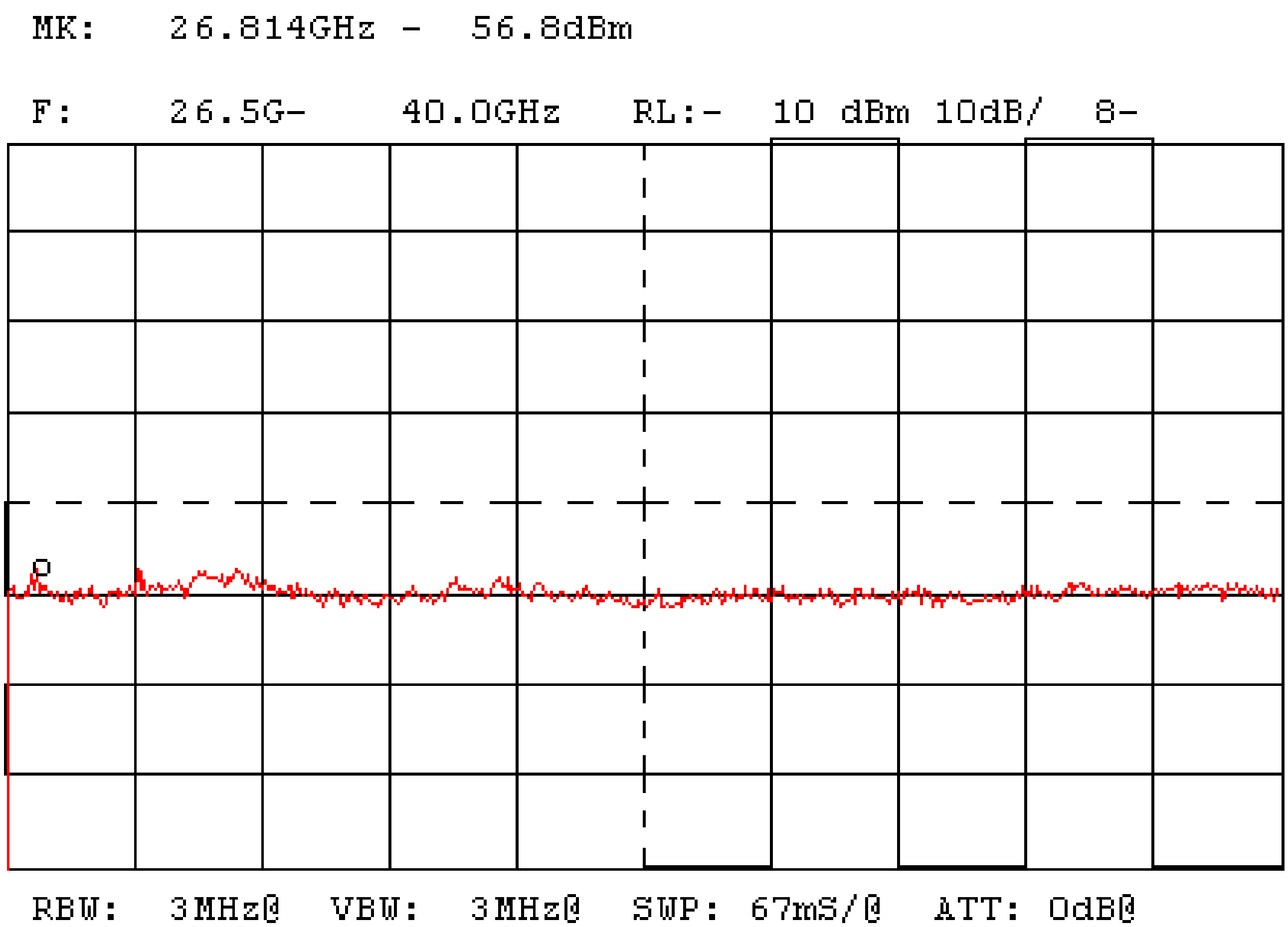

Horizontal polarization
Antenna factor=33.8 dB
Field strength=-56.8 dBm+107+33.8 –9.5 =74.5 dBuV/m

Graph 6-9: Field Strength of spurious radiation

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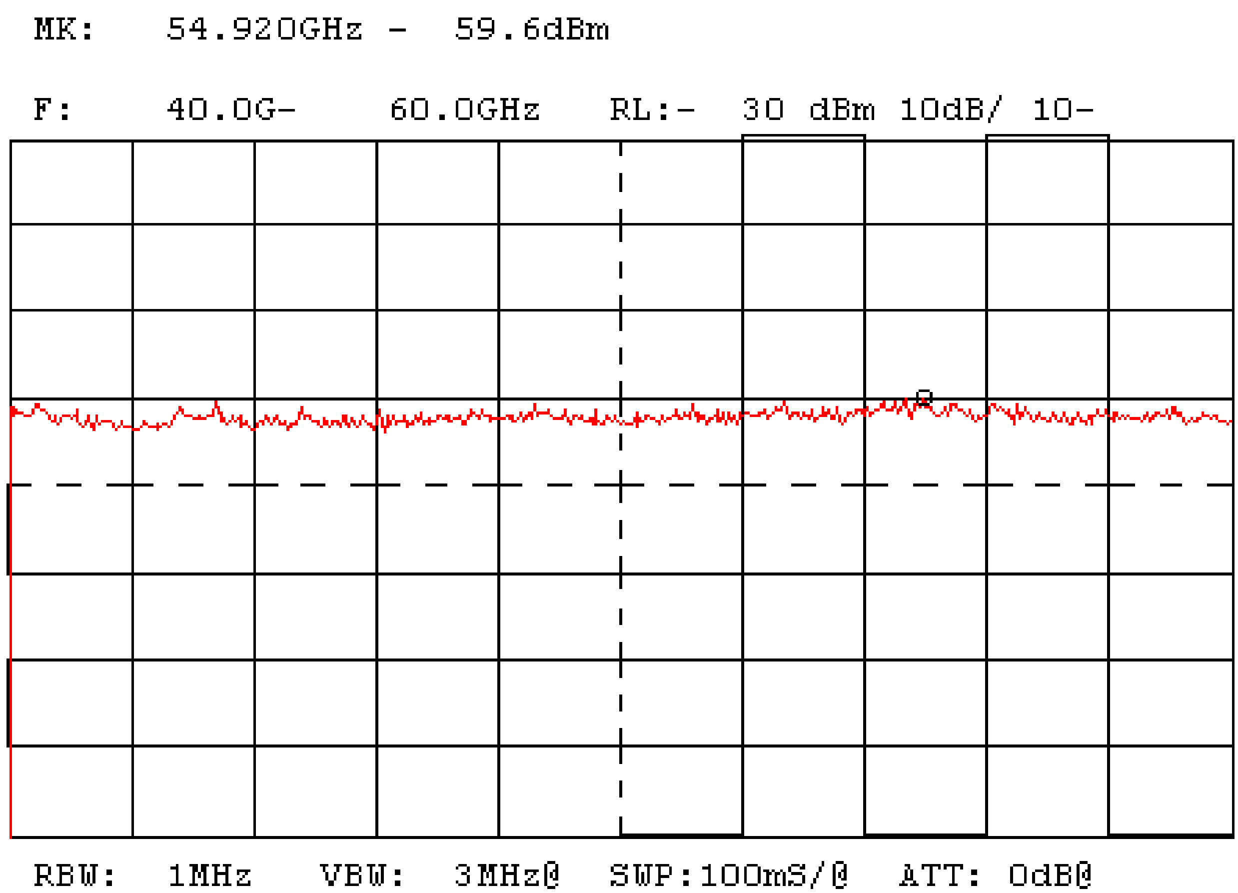

Horizontal polarization
Antenna factor=40 dB
Field strength=-59.6 dBm+107+40 –9.5 =77.9 dBuV/m

Graph 6-10: Field Strength of spurious radiation

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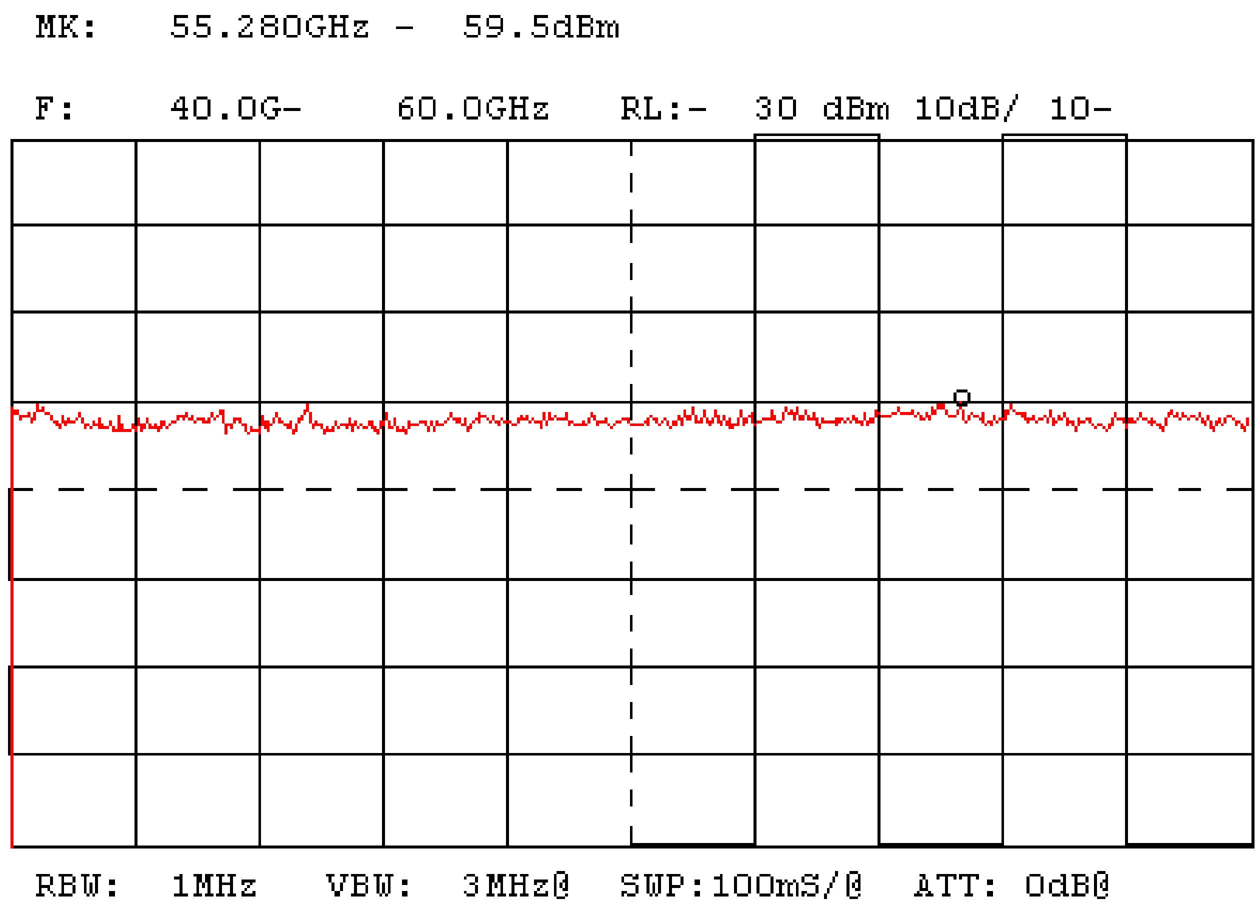

Vertical polarization
Antenna factor=40 dB
Field strength=-59.5 dBm+107+40 –9.5=78.0 dBuV/m

Graph 6-11: Field Strength of spurious radiation

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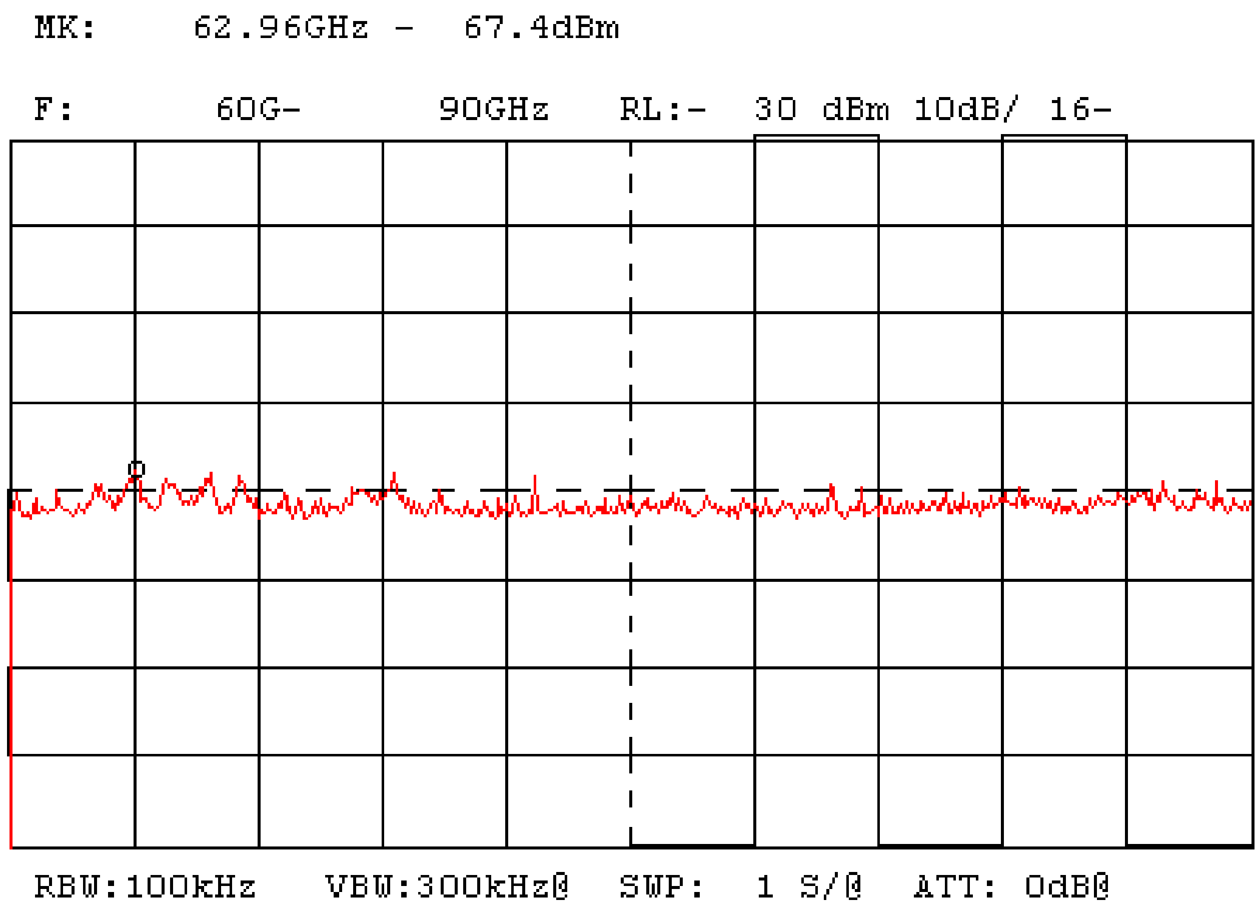

Horizontal polarization
Antenna factor=41.2 dB
Field strength=-67.4 dBm+107+41.2 –9.5 =71.3 dBuV/m

Graph 6-12: Field Strength of spurious radiation

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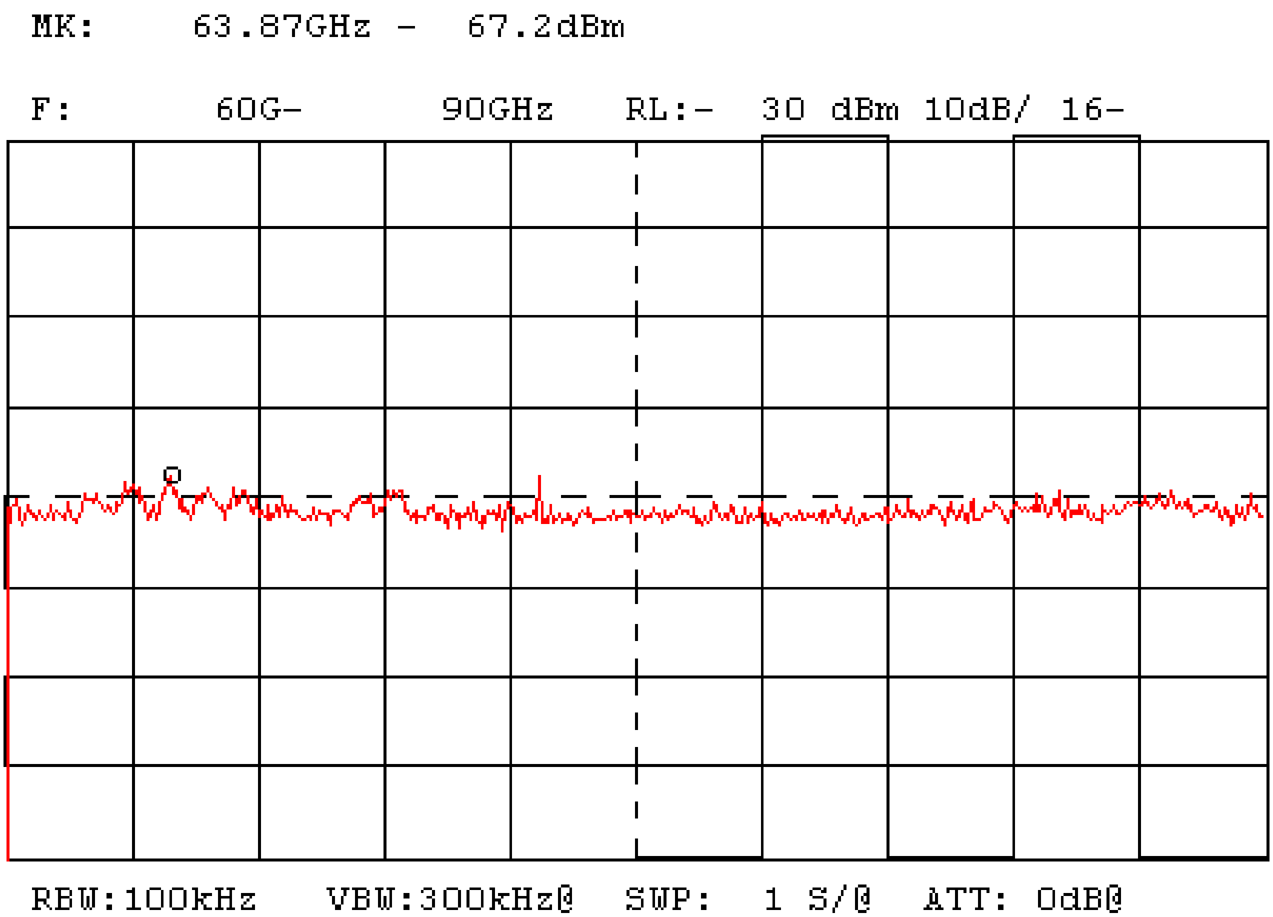

Vertical polarization
Antenna factor=41.3 dB
Field strength=-67.2 dBm+107+41.3 –9.5 = 71.6 dBuV/m

Graph 6-13: Field Strength of spurious radiation

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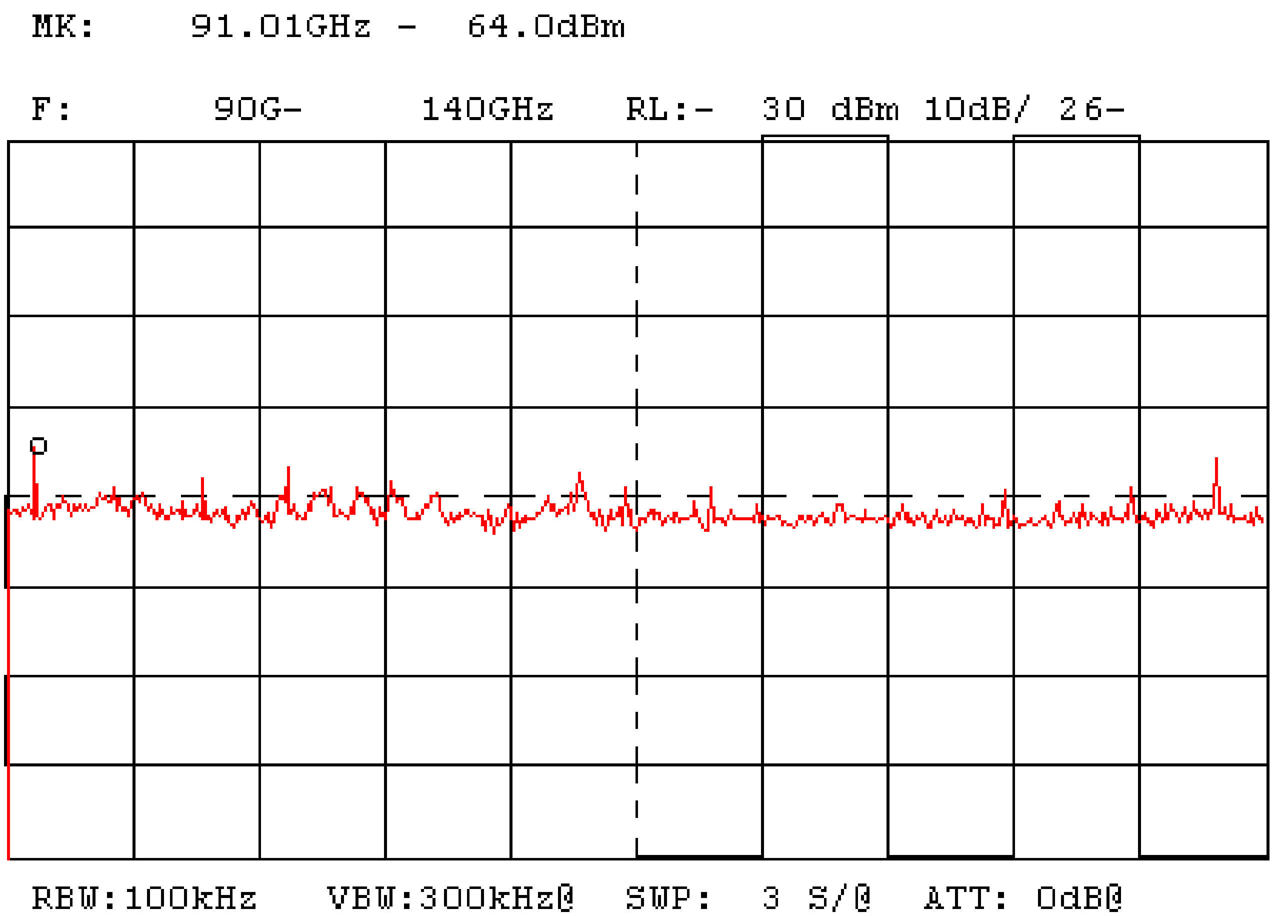

Vertical polarization
Antenna factor=44.4 dB
Field strength=-64 dBm+107+44.4 –9.5 =77.9 dBuV/m