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ACCREDITED
Certificate Number 1953-01

Amendment to Test Report
R011003-01

Company: BitsWave, Inc.
10700 Corporate Drive
Stafford, TX 77477
Contact: Richard Liu

Product: WaveLink Wireless adapter and remote unit
FCC ID: P5G-368-CC, base station
P5G-368-CC-R, remote unit
Test Report No: R011003-01A

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General Manager

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Test Engineer

DATE: 7 May 2003
Total Pages: 20

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1.0 Summary of test results

1.1 Test Results

The EUT was shown to comply with the guidelines for intentional radiators according to Parts 15.203, 15.209 and 15.249. See Section 4 for more detailed information.

1.2 Test Methods

The equipment was tested to comply with CFR 47, Part 15, for intentional radiators. The EUT was tested in accordance to methods of ANSI/IEEE C63.4, 2001. The configuration of the EUT was varied to maximize emissions. All measurements were made at a distance of 3 meters; the antenna height was varied from 1 meter to 4 meters. Both antenna polarizations were examined. The orientation of the EUT was first examined to determine in which position the EUT produced the greatest emissions.

1.3 Reason for amendment

This report is an amended version of NCEE report R011003-01. The report was amended to include complete the antenna and cable factors used in calculating the final level used in comparison to the FCC limits. This is found in Appendix B, Figure 13.

2.0 Description

2.1 Equipment under test

The WaveLink Wireless video game adapter is designed to allow a user to operate a gaming system at a greater distance from the monitor then would normally be possible with the wired system. The system uses a FSK radio modem running at 70 kbps with Manchester encoding to avoid frequency drifting. Frequency is controlled by a frequency synthesizer, which adjusts a voltage-controlled RF oscillator dynamically for accurate frequency management. Channel is set automatically by locating an unoccupied channel. A total of 8 channels can be selected conversing the frequency range of 910.7 – 917.7 MHz.

2.1.1 Identification: WaveLink Wireless video game adapter

2.1.2 EUT received date: 24 February 2003

2.1.3 EUT tested date: 4th, 5th, 6th and 7th March 2003

2.1.4 Manufacturer: BitsWave, Inc.

2.1.5 Serial numbers: FCC1

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility, which is a FCC registered lab. This site has been fully described in a report submitted to the FCC, and accepted in a letter dated May 4, 2001. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 56 ± 5%
Temperature of 24 ± 3° Celsius

2.3 Special equipment or setup

The EUT was tested while attached to a Sony PlayStation2 (PS2) Model #SCPH-30001, Serial # U4208949, with 2 Sony analog controllers (Model # SCPH-10010) attached to the remote unit. The present versions of the Sony PlayStation2 do not meet the conducted emissions requirements below 450kHz. The base station portion of the EUT (P5G-368-CC) was equipped with a momentary switch to allow the user to select the discrete transmit frequency.

3.0 Test equipment used

Serial #	*Manufacturer*	*Model*	*Description*	*Last cal.*
1654	EMCO	3142B	Biconilog antenna	3-May-02
6416	EMCO	3115	DRG Horn ant.	17-Sep-02
100037	Rohde & Schwarz	ESIB26	EMI Test Receiver	11-Jun-02
100023	Rohde & Schwarz	ESH3-Z5	LISN	20-Sep-02
2575	Rohde & Schwarz	ES-K1	Software v1.60	N/A

4.0 Detailed Results

All measurement results are located in the corresponding interval with a probability of approximately 95% (coverage factor k=2). The interval for these measurements is U_x (expanded uncertainty).

Conducted Emissions, 150kHz – 30MHz: U_x = +/- 3.1 dB
Radiated Emissions, 30MHz – 1GHz, 3m distance: U_x = +/- 3.4 dB
Radiated Emissions, 1GHz – 10GHz, 3m distance: U_x = +/- 3.7 dB

Radiated emissions measurements were made by first using a spectrum analyzer, getting signal spectrum, any points were then measured using a CISPR 16 compliant receiver with the following bandwidth setting:

30MHz - 1GHz: 120kHz IF bandwidth, 60kHz steps
1GHz - 12GHz: 1MHz IF bandwidth, 500kHz steps

Conducted measurements were made using a CISPR 16 compliant receiver with the IF bandwidth set to 9kHz taking 5kHz steps through the range 150kHz to 30MHz.
All results shown are corrected to incorporate cables losses, antenna factors, and any amplification.

4.1 FCC Part 15.203

The antenna is an embedded PCB antenna and there are no connectors attached to it or leading from the case. The plastic case is sealed. Thus the EUT complies with part 15.203.

4.2 FCC Part 15.249

4.2.1 Base Stations

The base station portion of the EUT was configured as shown in figures 1 and 2. The emissions at 550MHz coming from the configuration tested were found to be caused by the auxiliary equipment. The out of band emissions shown in Figure 11 that appear to be over the limit were due to a loose audio/video cable on the back of the PS2. When the cable was properly inserted, the emissions were within the limits. An averaging factor (-9.12dB) was applied based on the worst-case transmission duration as shown in Figure 6. The base station (worst-case) produces 14 peaks @ 2.5ms/peak in a given 100ms period. Measurements were made to the 10^{th} harmonic; beyond the values listed in Appendix B, Figure 13, there were no detectable emissions. The "Adjusted level" in Figure 13 includes all path corrections and the averaging factors.

4.2.2 Remote Unit

The remote unit portion of the EUT was configured as shown in figures 3 and 4. Up to two game controllers plug into the remote unit. An averaging factor (-7.29dB) was applied based on the worst-case transmission duration as shown in Figure 7. The longer transmissions were coming from the remote unit. The remote produces 6 peaks @ 7.2ms/peak in a given 100ms period. Measurements were made to the 10^{th} harmonic; beyond the values listed in Appendix B, Figure 13, there were no detectable emissions. The "Adjusted level" in Figure 13 includes all path corrections and the averaging factors.

4.3 FCC Part 15.207

The base station caused no emissions in the frequency band of 450kHz to 30MHz to exceed the published limits as shown in Figure 8. The EUT was configured as shown in Figure 5. Below 450kHz, the auxiliary equipment caused the unit as there is little difference between the results with the without the EUT. The remote portion has no provision to tie into the public mains system.

4.4 FCC Part 15.209

Both units had no emissions within 15dB of the limits when not transmitting.

Appendix A

Test setup photos

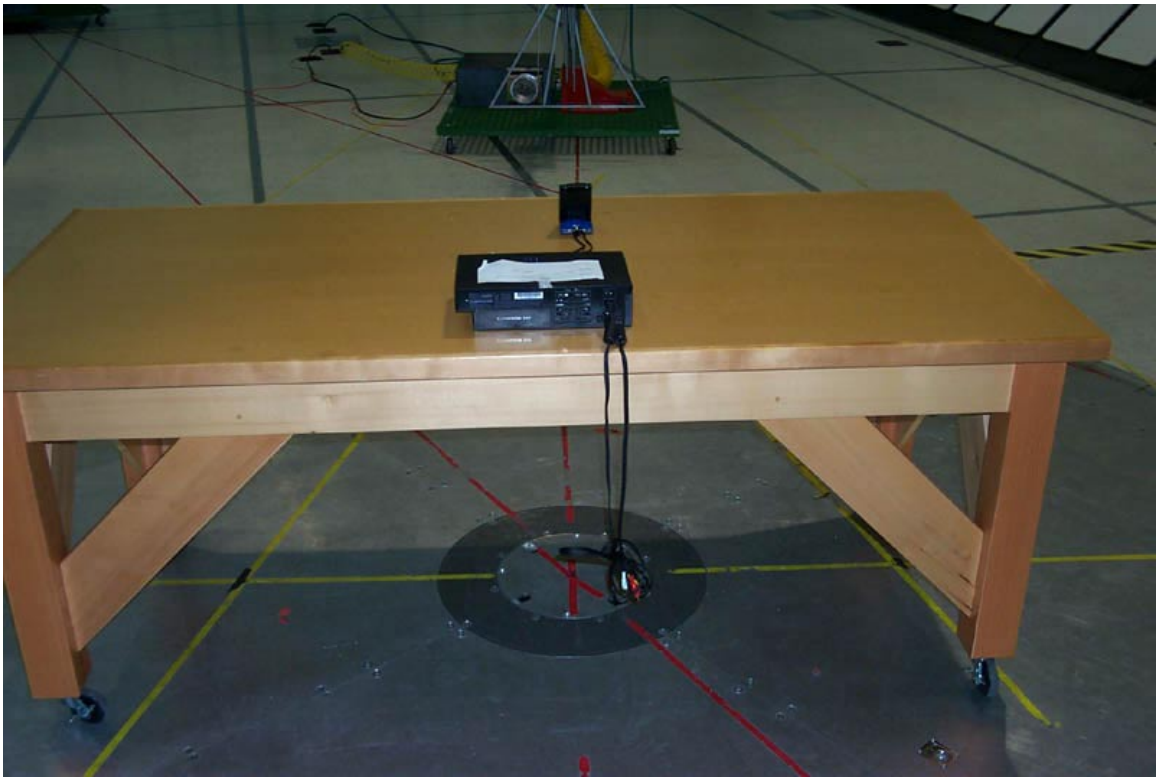

Figure 1 Test Setup of base station

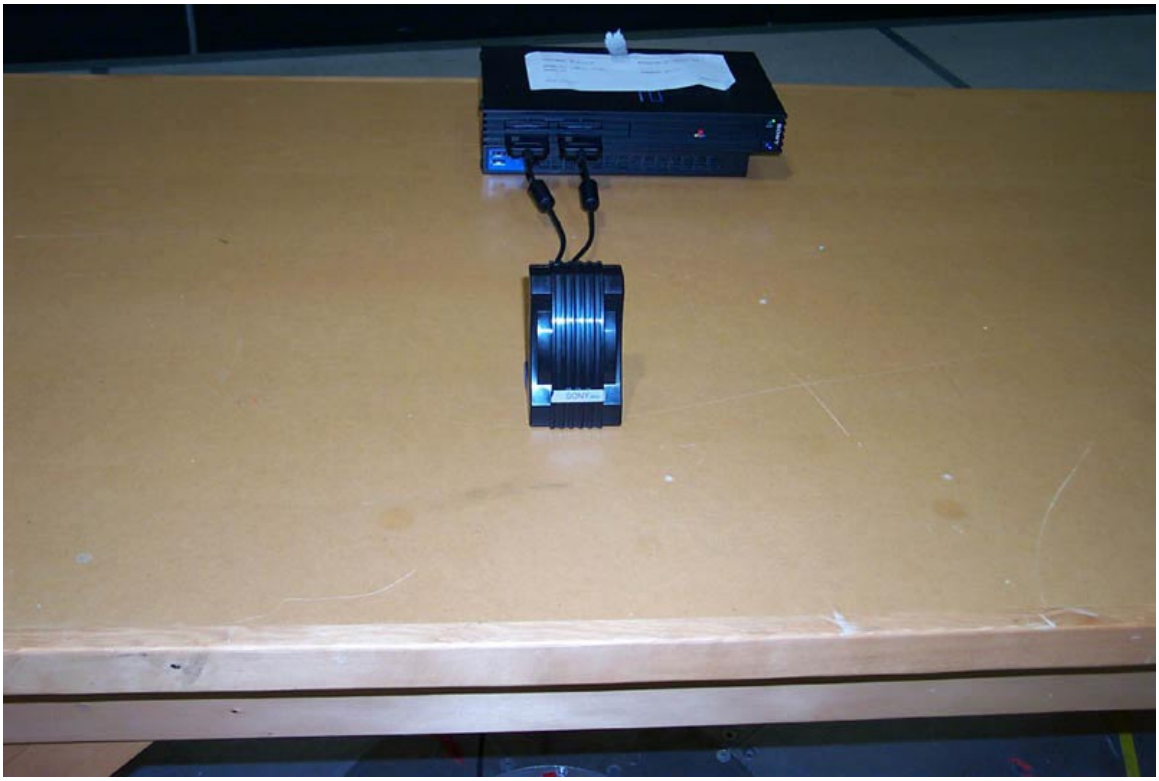

Figure 2 Test Setup of base station

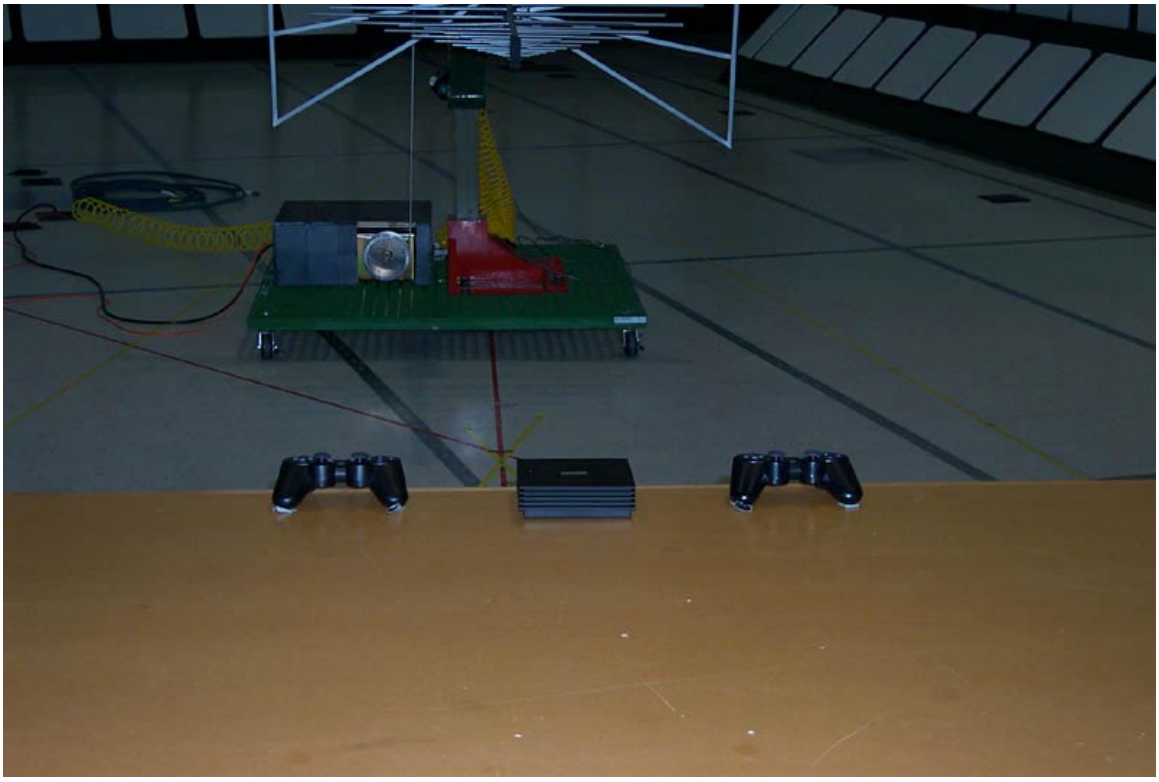

Figure 3 Test Setup of remote unit with controllers attached

Figure 4 Test Setup of remote unit with controllers attached

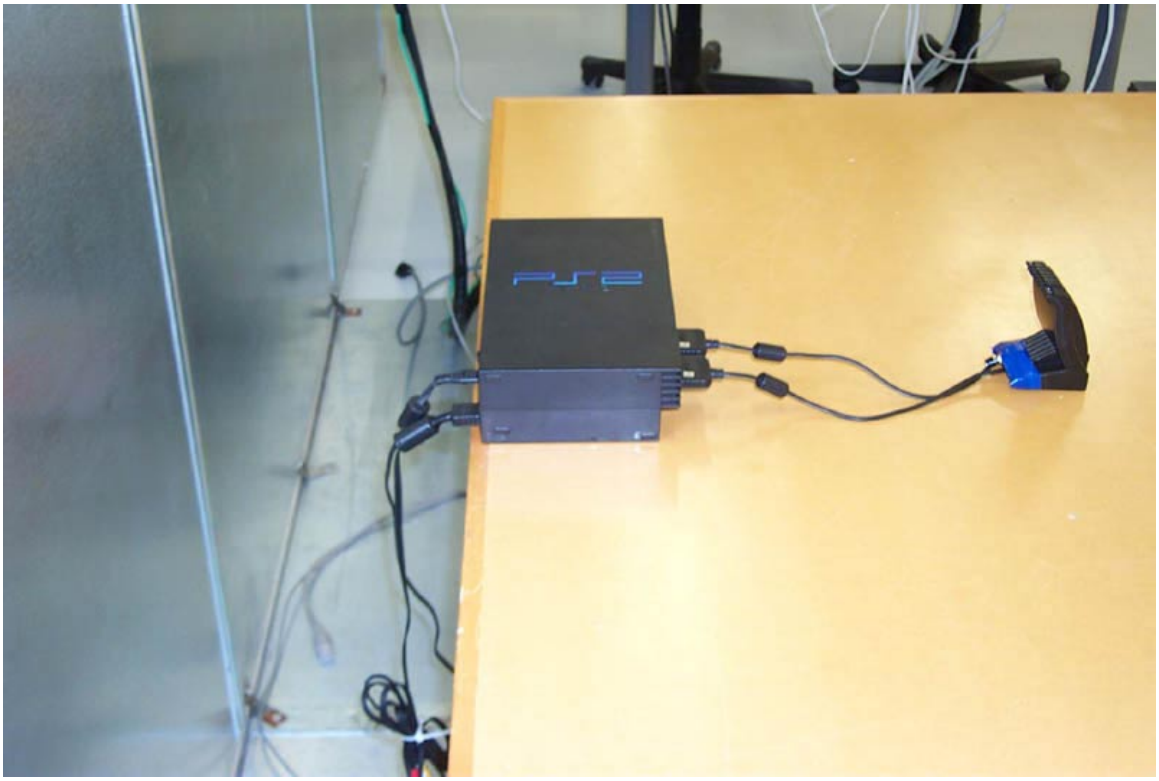

Figure 5 Conducted emissions test setup

Appendix B

Emissions results

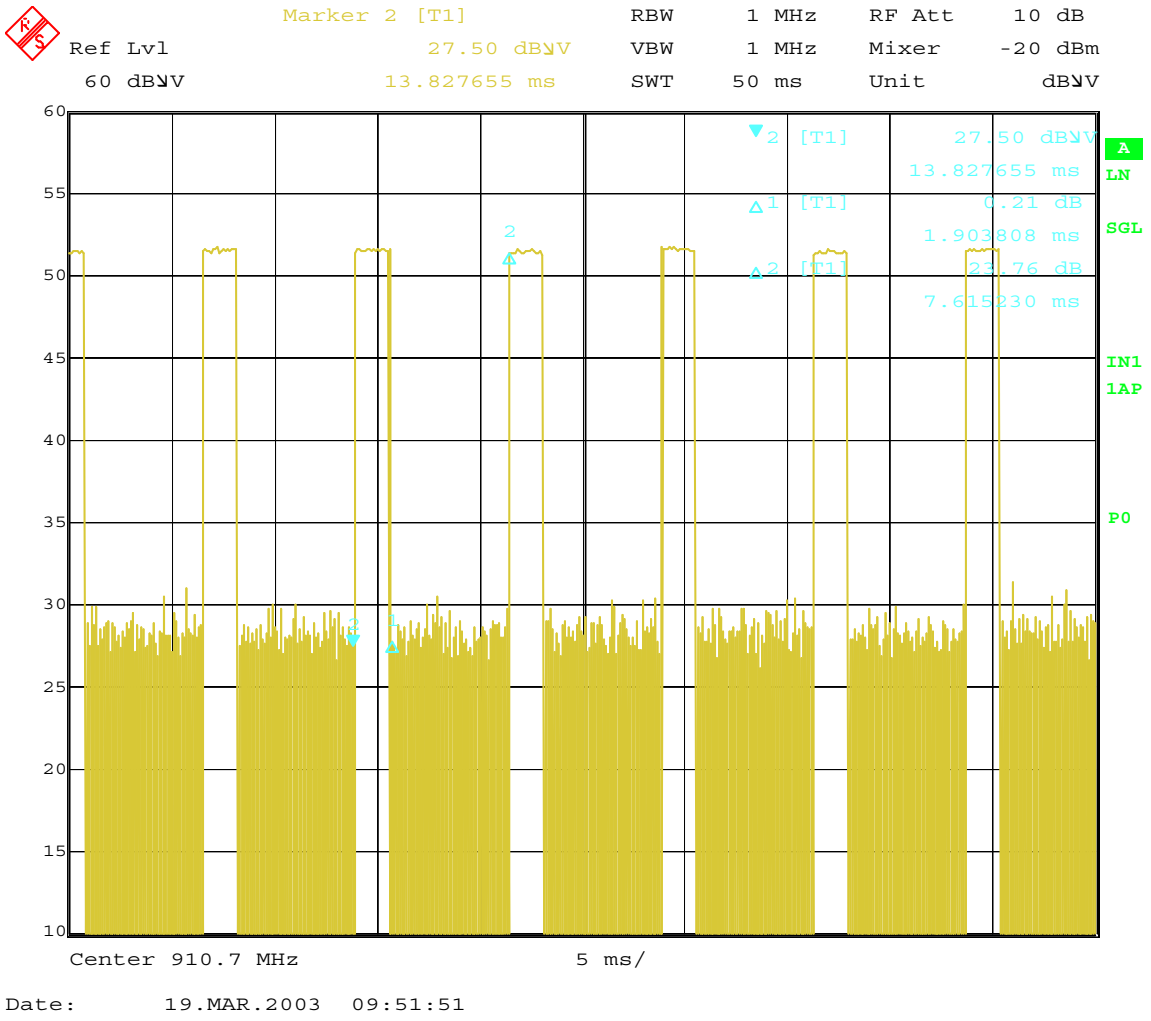

Figure 6 Worst-case pulse train of base station unit alone

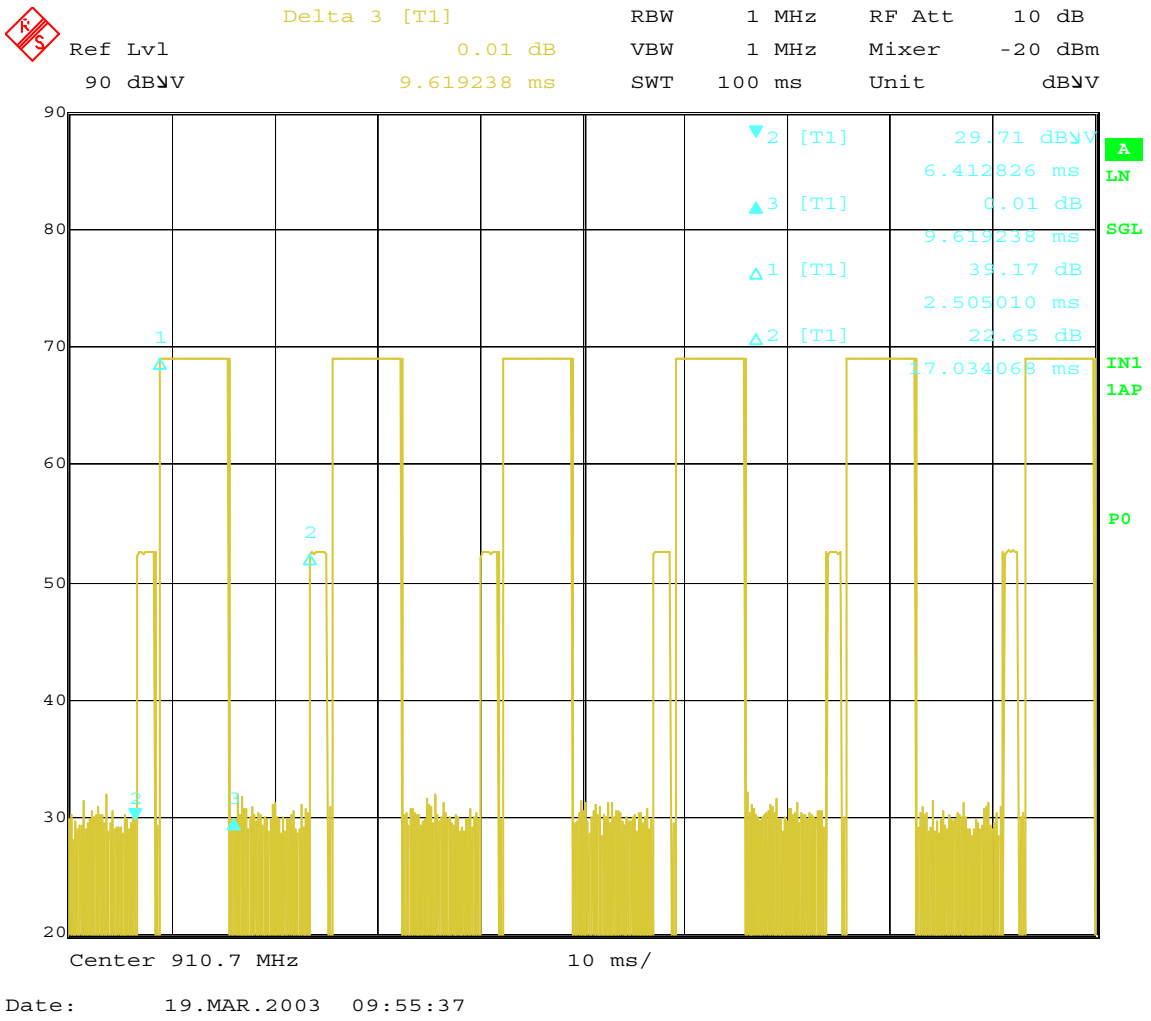

Figure 7 Remote and base station units together, higher pulses are remote unit

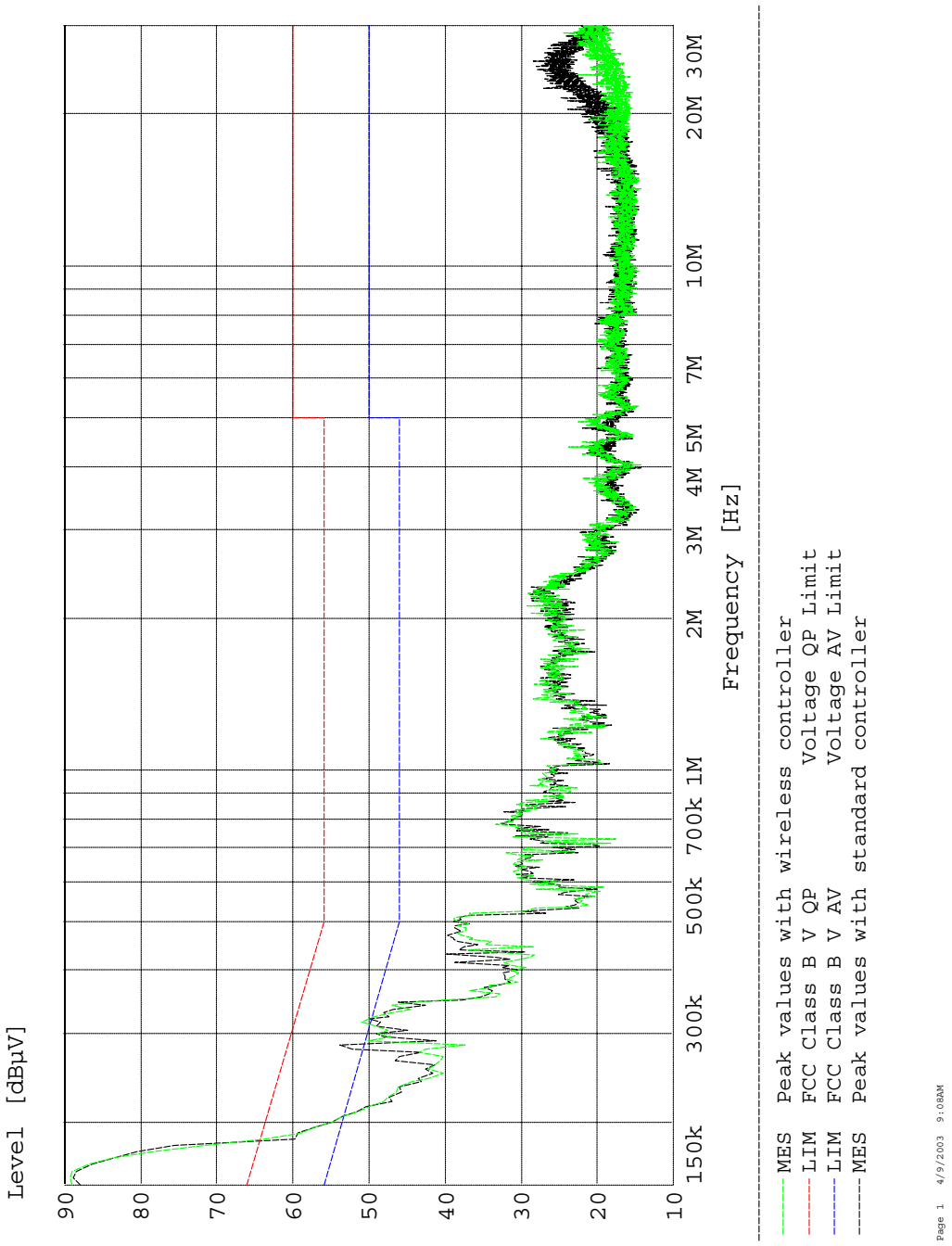

Figure 8 Conducted emissions

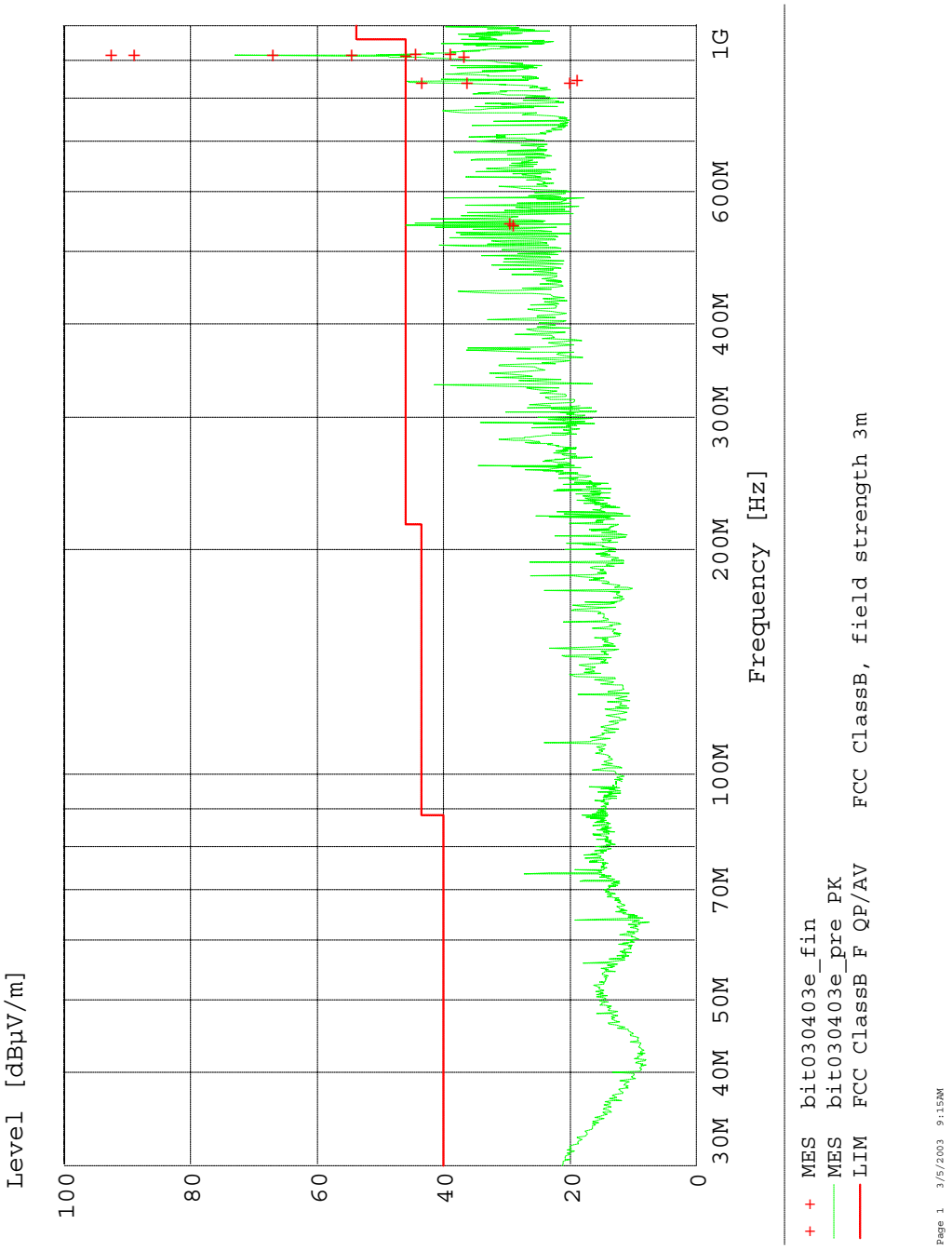

Figure 9 Radiated emissions below 1GHz, base station, 911.7MHz

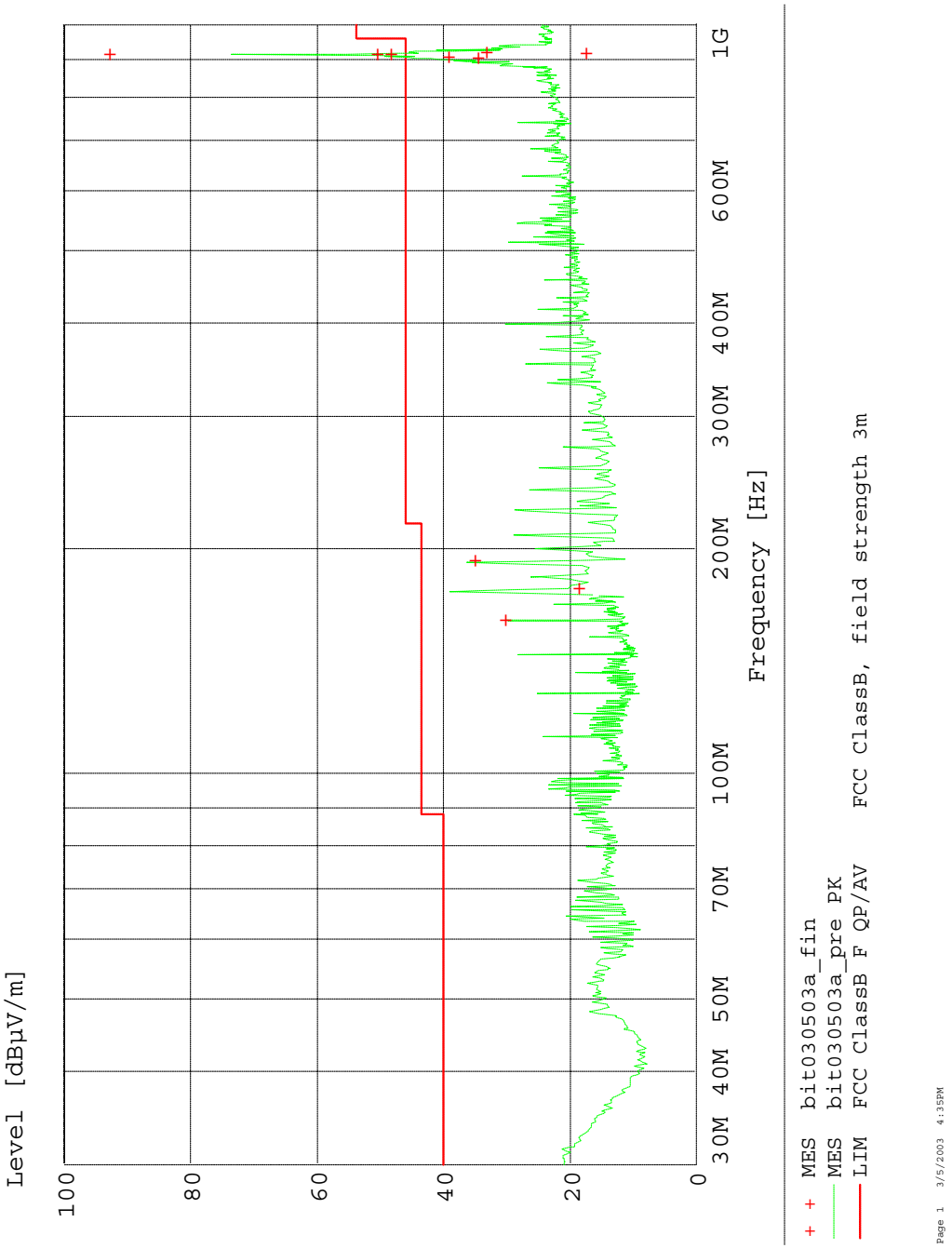

Figure 10 Radiated emissions below 1GHz, remote unit, 911.7MHz

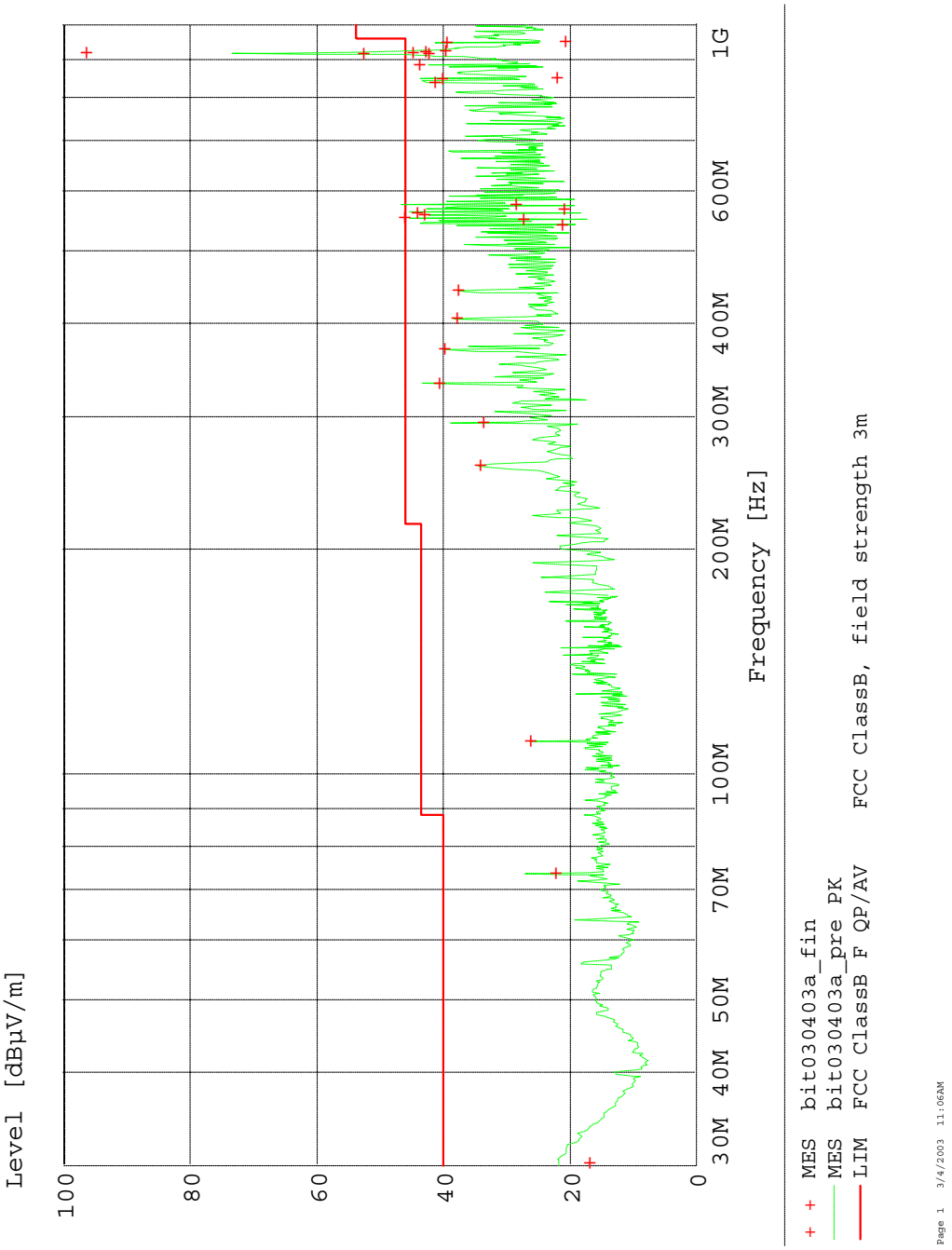

Figure 11 Radiated emissions below 1GHz, base station, 916.7MHz

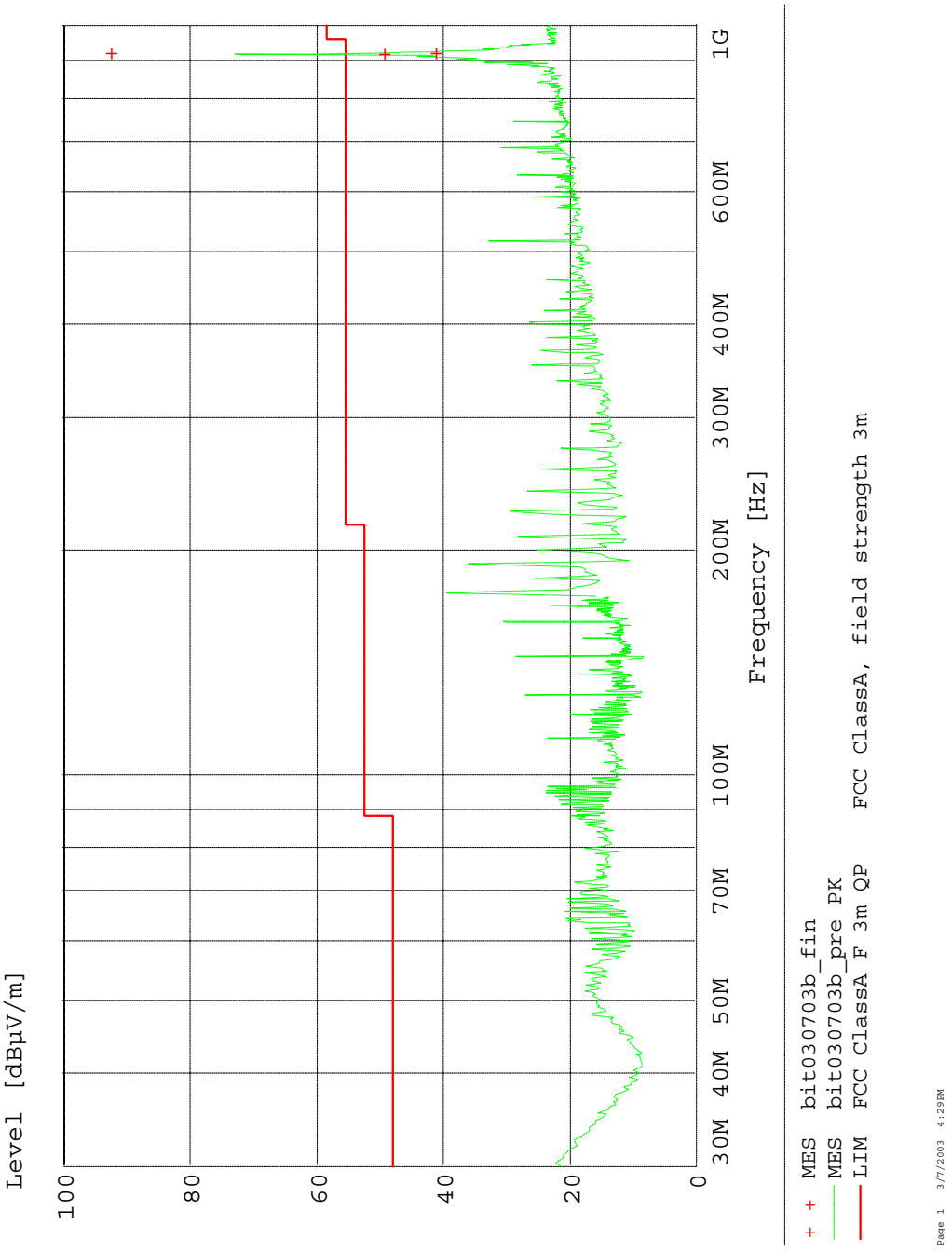

Figure 12 Radiated emissions below 1GHz, remote unit, 916.7MHz

BASE STATIONS

Lower Frequency: 911.7MHz

Frequency MHz	Level* dBµV/m	Adjusted Level dBµV/m	Averaging Factor (dB)	Antenna Factors	Cable loss (dB)	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.	Comment
911.70	93.22	84.10	-9.12	24.10	26.50	94.00	9.90	106.00	127.00	HORIZONTAL	Emissions near the limit below 911.7MHz coming from PS2 independent of EUT
1769.50	48.38	39.26	-9.12	27.90	24.70	53.90	14.64	150.00	157.00	HORIZONTAL	2nd harmonic
2734.00	37.26	28.14	-9.12	31.00	21.80	53.90	25.76	201.00	21.00	HORIZONTAL	3rd harmonic
3647.50	42.05	32.93	-9.12	33.30	20.60	53.90	20.97	214.00	26.00	HORIZONTAL	4th harmonic
4559.00	42.20	33.08	-9.12	34.10	19.30	53.90	20.82	214.00	63.00	HORIZONTAL	5th harmonic
5471.00	38.57	29.45	-9.12	36.20	18.70	53.90	24.45	201.00	60.00	HORIZONTAL	6th harmonic

Upper Frequency: 916.7MHz

Frequency MHz	Level* dBµV/m	Adjusted Level dBµV/m	Averaging Factor (dB)	Antenna Factors	Cable loss (dB)	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.	Comment
916.80	96.98	87.86	-9.12	24.10	26.50	94.00	6.14	118.00	88.00	VERTICAL	Emissions near the limit below 916.8MHz coming from PS2 independent of EUT
1833.50	48.90	39.78	-9.12	28.10	24.60	53.90	14.12	201.00	82.00	VERTICAL	2nd harmonic
2748.50	32.52	23.40	-9.12	31.10	21.80	53.90	30.50	214.00	64.00	VERTICAL	3rd harmonic
3667.00	43.16	34.04	-9.12	33.40	20.60	53.90	19.86	214.00	67.00	VERTICAL	4th harmonic
4583.50	43.51	34.39	-9.12	34.10	19.20	53.90	19.51	214.00	63.00	VERTICAL	5th harmonic
5501.00	40.76	31.64	-9.12	36.20	18.60	53.90	22.26	214.00	65.00	VERTICAL	6th harmonic
6417.00	34.50	25.38	-9.12	36.40	17.70	53.90	28.52	214.00	31.00	VERTICAL	7th harmonic

*Corrected for signal path
Cable losses include preamp.

REMOTE UNITS

Lower Frequency: 911.7MHz

Frequency MHz	Level* dBµV/m	Adjusted Level dBµV/m	Averaging Factor (dB)	Antenna Factors	Cable loss (dB)	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.	Comment
911.7	100.39	93.10	-7.29	24.10	26.50	94	0.90	100	310	HORIZONTAL	
1823.5	62.01	54.72	-7.29	28.10	24.60	58.5	3.78	106	320	HORIZONTAL	2nd harmonic
2735	55.09	47.80	-7.29	31.00	21.80	58.5	10.70	119	304	HORIZONTAL	3rd harmonic
3648.5	41.27	33.98	-7.29	33.30	20.60	58.5	24.52	119	306	HORIZONTAL	4th harmonic
4557	41.01	33.72	-7.29	34.10	19.30	58.5	24.78	99	312	HORIZONTAL	5th harmonic
5471	52.94	45.65	-7.29	36.20	18.70	58.5	12.85	119	320	HORIZONTAL	6th harmonic
6382.5	65.7	58.41	-7.29	36.40	17.70	58.5	0.09	106	316	HORIZONTAL	7th harmonic

Upper Frequency: 916.7MHz

Frequency MHz	Level* dBµV/m	Adjusted Level dBµV/m	Averaging Factor (dB)	Antenna Factors	Cable loss (dB)	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.	Comment
916.74	93.01	85.72	-7.29	24.10	26.50	94	8.28	301	221	VERTICAL	
1833.5	62.82	55.53	-7.29	28.10	24.60	58.5	2.97	118	263	VERTICAL	2nd harmonic
2750.5	62.25	54.96	-7.29	31.10	21.80	58.5	3.54	119	268	VERTICAL	3rd harmonic
3668.5	41.88	34.59	-7.29	33.40	20.60	58.5	23.91	115	277	VERTICAL	4th harmonic
4582	40.75	33.46	-7.29	34.10	19.20	58.5	25.04	99	268	VERTICAL	5th harmonic
5499.5	55.7	48.41	-7.29	36.20	18.60	58.5	10.09	100	265	VERTICAL	6th harmonic
6416	38.97	31.68	-7.29	36.40	17.70	58.5	26.82	106	265	VERTICAL	7th harmonic

*Corrected for signal path
Cable losses include preamp.

Figure 13 Tabular results data

Appendix C

Sample calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF – (CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude (measured)

AF = Antenna Factor (+dB)

CF = Cable Attenuation Factor (-dB)

AG = Amplifier Gain (+dB)

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBµV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBµV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m