EMC Technologies (NZ) Ltd

Test Report No **60819.4**
Report date: 11 September 2006

TEST REPORT

Trimble Geo Explorer 2005 Handheld GPS with 802.11b and 802.11g WLAN

tested to the

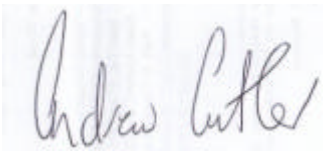
Code of Federal Regulations (CFR) 47

Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators

Section 15.247 – Operation in the band 2400 – 2483.5 MHz

for

Trimble Navigation New Zealand Ltd



This Test Report is issued with the authority of:

Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. CLIENT INFORMATION

Company Name	Trimble Navigation NZ Ltd
Address	PO Box 8729 Riccarton
City	Christchurch
Country	New Zealand
Contact	Mike Oosterman
Email	mike.oosterman@trimble.co.nz

2. DESCRIPTION OF TEST SAMPLE

Brand Name	Trimble
Model Number	GeoExplorer 2005
Product	Handheld GPS with 802.11b+g WLAN Module
Manufacturer	Trimble Navigation NZ Ltd
Country of Origin	New Zealand
Serial Number	4537461959
FCC ID	JUP613

3. COMPLIANCE STATEMENT

The **Trimble Geo Explorer 2005 Handheld GPS with 802.11b + g WLAN Transmitter Module** complies with 47 CFR Part 15 and in particular Sections, 15.205, 15.207, 15.209 and 15.247 when tested in accordance with ANSI C63.4-2003 & DA-00-705.

CLAUSE	TEST PERFORMED	RESULT
15.203	Antenna requirement	Complies
15.205	Operation in restricted bands	Complies
15.207	Conducted emissions	Complies
15.209	Radiated emissions	Complies
15.247:		
(a)(1)	FHSS channel bandwidth	Not applicable
(a)(1)(iii)	FHSS channel occupancy	Notapplicable
(a)(2)	Digital modulation bandwidth	Complies
(b)(1)	FHSS peak output power	Not applicable
(b)(3)	Digital peak output power	Complies
(c)	Antenna gains exceeding 6 dBi	Not applicable
(d)	Spurious emissions	Complies
(e)	Digital modulation power spectral density	Complies
(f)	Hybrid systems	Noted
(g)	Hopping systems	Noted
(h)	Hopping systems intelligence	Noted
(i)	Radio frequency hazard	Not tested

4. TEST SAMPLE DESCRIPTION

The sample tested is a Hand Held GPS unit which is contained within a Pocket PC that includes a module containing 802.11b + g WLAN transmitters to enable the device to communicate with other computing devices using wireless technology.

Modulation system used

802.11b WLAN: Direct sequence spread spectrum at 1, 2, 5.5 and 11 Mbps

802.11g WLAN: Direct sequence spread spectrum at 6, 9, 12, 18, 24, 36, 48 and 54 Mbps

Rated Module Output Power

WLAN: 14.5 dBm

Antenna Type

WLAN: ¼ whip monopole

Test frequencies

WLAN: 2412 MHz, 2437 MHz, 2462 MHz

Power Supply

Device is powered by internal batteries.

Device can be operated while sitting in the charger base which can be powered from 110 Vac or 230 Vac.

Device can also be operated when powered at 12 Vdc in a vehicle using an in car adaptor that attached to what is known as a serial clip.

5. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

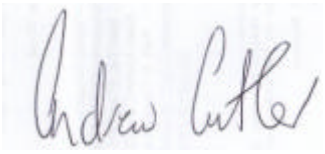
This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

6. TRANSMITTER TEST RESULTS

Section 15.203 – Antenna requirement

The device has an integral antenna that is attached permanently.

Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.247 (c).

Section 15.207 – Conducted emissions

Normally this device operates using internal batteries.

However the device can be operated while sitting in a charger base (Cradle Guad 2 P/N 53500-00).

Testing was carried out with the device was operating while attached to the charger base when powered at 110 Vac while in standby mode and when transmitting continuously in WLAN and Bluetooth modes and with the GPS Receiver operating.

Conducted emissions testing was carried out over the frequency range of 150 kHz to 30 MHz.

Testing was carried out in the laboratory's MacKelvie Street screened room.

The device was placed on top of the test table, which is 1m x 1.5m, 80cm above the screened room floor which acts as the horizontal ground plane. In addition the device was positioned 40cm away from the screened room wall which acts as the vertical ground plane. The artificial mains network was bonded to the screened room floor. At all times the device was kept more than 80cm from the artificial mains network.

Quasi-Peak and Average measurements were made with a receiver bandwidth of 9 kHz.

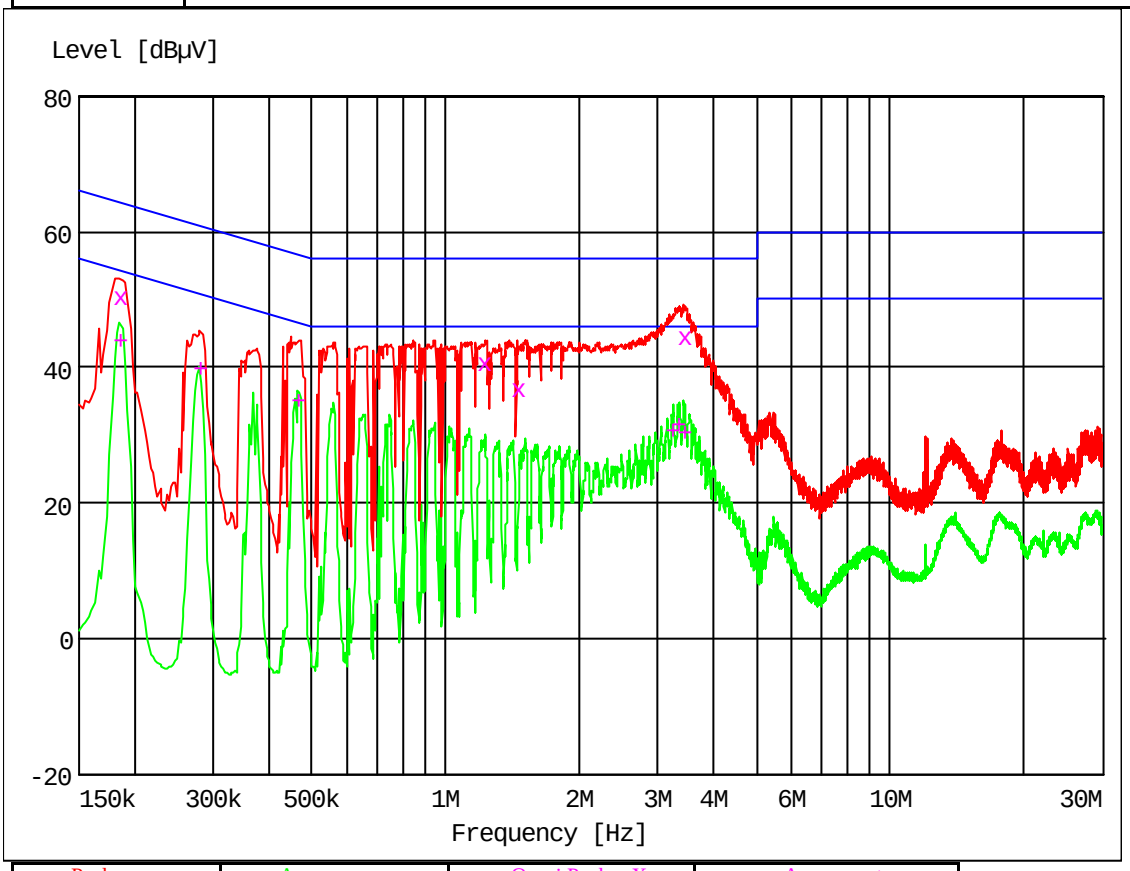
The supplied plot shows combined graphs of measurements made on both the phase and neutral AC voltage supply lines.

Measurement uncertainty with a confidence interval of 95% is:
- Mains terminal tests (0.15 - 30 MHz) ± 2.2 dB

Result: Complies

Conducted emissions

Comments:	Device tested in standby mode charging the battery with the PDA and GPS modules turned on when powered at 110 Vac.



Peak -------	Average -------	Quasi Peak X	Average +

Quasi-Peak Measurements

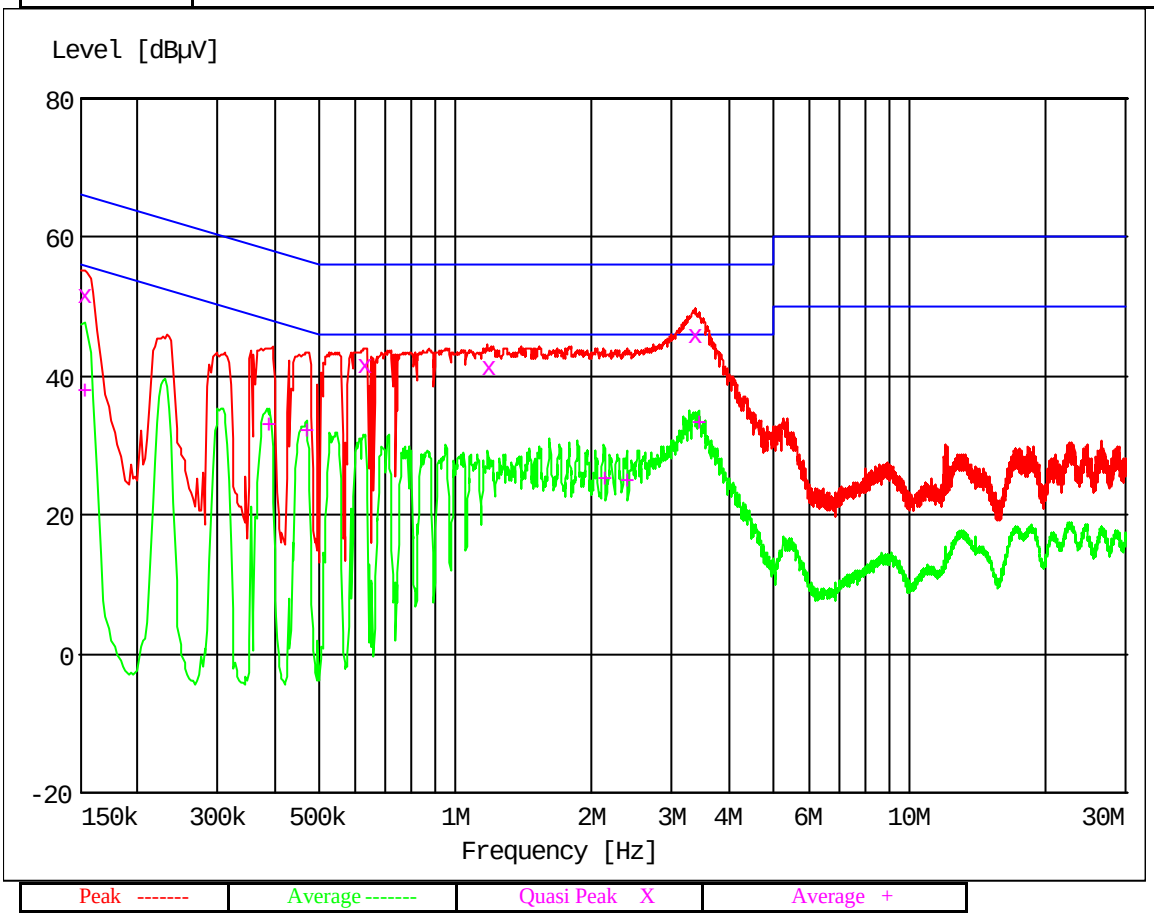
Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.185000	50.80	64.2	13.3	L1	50.0
1.225000	41.20	56.0	14.7	L1	
1.447500	37.20	56.0	18.7	L1	
3.440000	44.80	56.0	11.1	L1	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.185000	44.30	54.2	9.9	L1	
0.280000	40.10	50.8	10.6	L1	
0.465000	35.40	46.6	11.1	L1	
3.245000	31.10	46.0	14.8	L1	
3.350000	32.00	46.0	13.9	L1	
3.425000	30.90	46.0	15.0	L1	

Conducted emissions

Comments:	Device tested when powered at 110 Vac when the Wireless LAN and the Bluetooth transmitters were transmitting continuously with the GPS also activated.



Quasi-Peak Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.152500	52.10	65.8	13.6	L1	
0.630000	42.00	56.0	13.9	L1	
1.177500	41.50	56.0	14.4	L1	
3.365000	46.10	56.0	9.8	L1	45.0

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.152500	38.10	55.8	17.6	L1	
0.390000	33.40	48.0	14.6	L1	
0.470000	32.50	46.5	14.0	L1	
2.125000	25.50	46.0	20.4	L1	
2.380000	25.10	46.0	20.8	L1	
3.425000	33.60	46.0	12.3	L1	

Section 15.247 (a) (2) – Digital modulation channel bandwidth

The WLAN device tested was a Direct Sequence Spread Spectrum transmitter that could be programmed to operate on one of 11 channels between 2412 MHz and 2462 MHz with a channel spacing of 5 MHz.

Direct Sequence Spread Spectrum transmitters are systems using digital modulation techniques.

This module can operate using IEEE 802.11b and IEEE 802.11g modes of operation at various data speeds.

In the band 2400 – 2483.5 MHz the minimum 6 dB bandwidth shall be at least 500 kHz.

All measurements were made using radiated methods using software supplied by the client.

The –6dB bandwidth has been measured at 2412, 2437 and 2462 MHz using a spectrum analyser in peak hold mode and a horn antenna.

A resolution bandwidth of 100 kHz has been utilised.

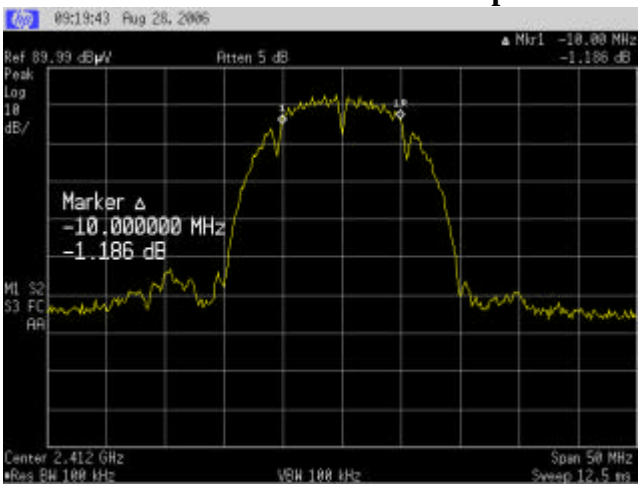
Testing was carried out on channel 1 (2412 MHz) in the following modes:
- 802.11a at 1, 5.5 and 11 Mbps
- 802.11g at 6, 12, 24 and 54 Mbps

Testing has also been carried out on channels 6 and 11 using the mode that gave the widest bandwidth on channel 1.

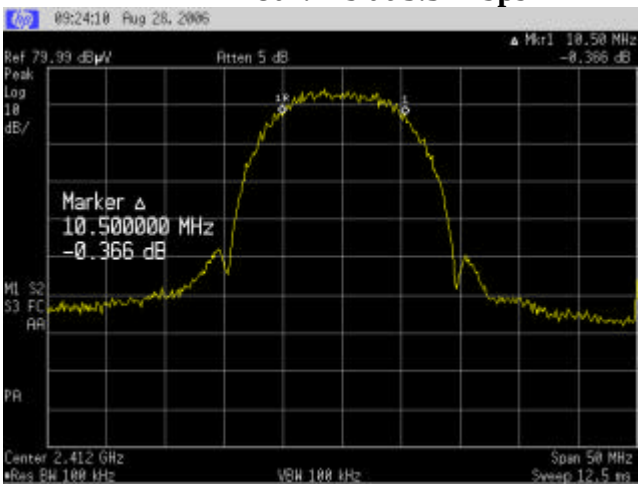
The 6 dB bandwidths were observed to be approximately 10 MHz for the 802.11a modes and 16.750 MHz for the 802.11g modes

Result: Complies

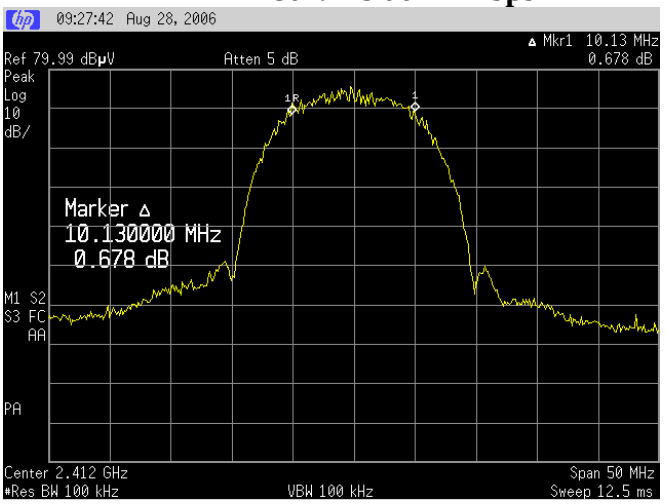
2412 MHz 802.11b at 1 Mbps



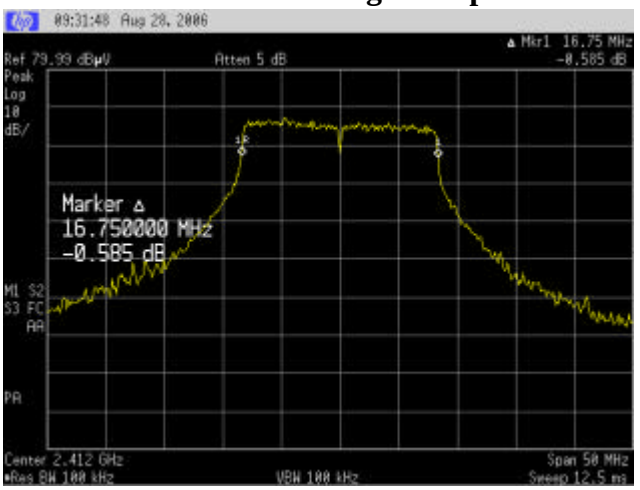
2412 MHz 802.11b at 5.5 Mbps



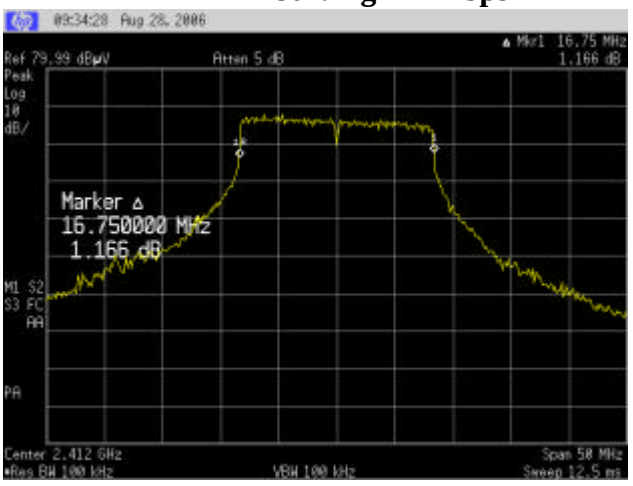
2412 MHz 802.11b at 11 Mbps



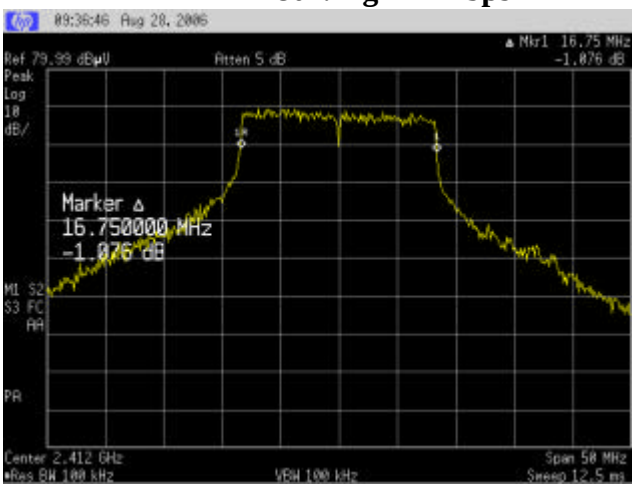
2412 MHz 802.11g 6 Mbps



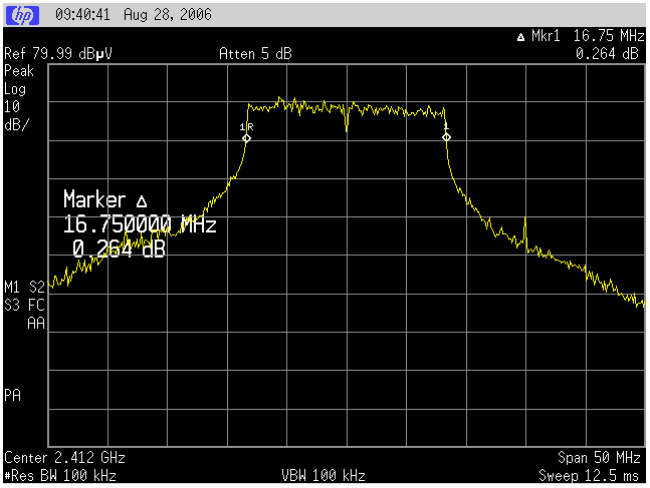
2412 MHz 802.11g 12 Mbps



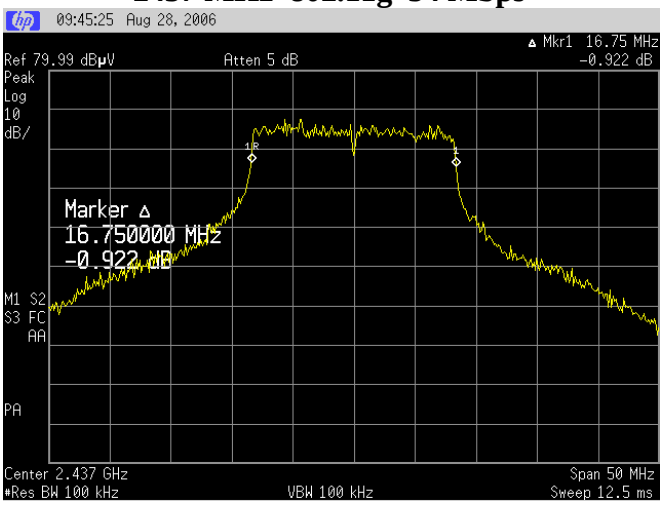
2412 MHz 802.11g 24 Mbps



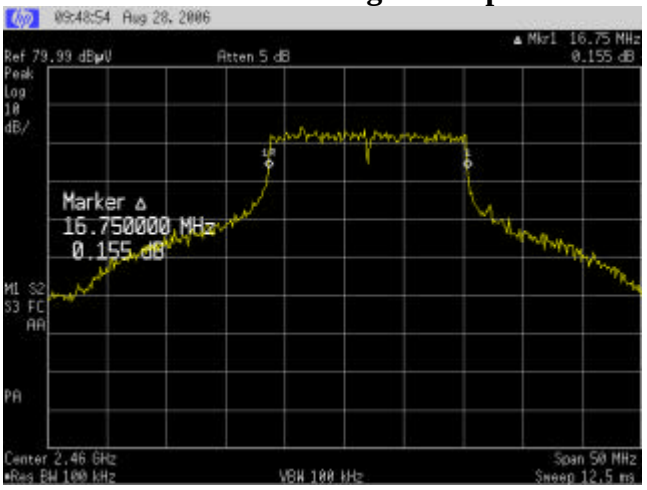
2412 MHz 802.11g 54 Mbps



2437 MHz 802.11g 54 Mbps



2462 MHz 802.11g 54 Mbps



Section 15.247 (b) (1) & (3) – Peak output power

As this device has no external antenna port, with the antenna being located internally; radiated measurements were made to determine the peak output power.

The device was placed on the test table, being 80 cm above the ground plane, with the computer screen display facing the test antenna located 3 metre away.

The device was rotated in order to determine the highest power output indication.

Measurements of the WLAN device were made with the spectrum analyser operating in peak hold mode with a resolution bandwidth of 5 MHz.

Testing was carried out on channel 1 (2412 MHz) in the following modes:
- 802.11a at 1, 5.5 and 11 Mbps
- 802.11g at 6, 12, 24 and 54 Mbps

Testing has also been carried out on channels 6 and 11 using the mode that gave the highest power level on channel 1.

As the bandwidth of the emission exceeded the resolution bandwidth of the spectrum analyser power measurements were made in 5 MHz steps across the frequency band occupied by the emission and were then summed to give a final power level.

Frequency MHz	Mode	Data Rate (Mbps)	Level dBm	Limit dBm	Result
2412.0	802.11a	1.0	6.4	30.0	Pass
2412.0	802.11a	5.5	4.7	30.0	Pass
2412.0	802.11a	11.0	5.3	30.0	Pass
2412.0	802.11g	6.0	5.5	30.0	Pass
2412.0	802.11g	12.0	7.4	30.0	Pass
2412.0	802.11g	24.0	9.0	30.0	Pass
2412.0	802.11g	54.0	7.7	30.0	Pass
2437.0	802.11g	24.0	6.5	30.0	Pass
2462.0	802.11g	24.0	4.2	30.0	Pass

The specification limit is 30 dBm (1.0W).

Section 15.247 (c) – Out of band emissions

As the transmitter does not have an external antenna port radiated measurements were made at the open area test site.

Testing was carried when transmitting continuously on 2402 MHz, 2440 MHz and 2480 MHz in Bluetooth mode and on 2412 MHz, 2437 MHz and 2462 MHz in WLAN mode.

The device was placed on the test table, being 0.8 m above the ground plane, with the front display facing the test antenna.

Measurements were made using a resolution bandwidth of 100 kHz where an emission fell outside of a restricted band.

When an emission fell within a restricted band, above 1 GHz, a peak detector and an average detector with a resolution bandwidth of 1 MHz were utilised in accordance with section 15.209.

Below 1 GHz a quasi peak detector with a resolution bandwidth of 120 kHz was utilised.

All measurements were initially made over a distance of 3 metres.

Above 1 GHz pre-testing was carried out at a distance of 10 cm as the emission levels from the device were very low.

In the unrestricted bands measurements were made to determine if the field strength of the emissions observed were more than 20 dB down on the highest in band emission level.

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height with an automated antenna tower. The emission is measured in both vertical and horizontal antenna polarisations.

The emission level is determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB) + Coax Loss (dB) – Amplifier Gain (dB)

WLAN Transmitting on 2412 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2412	102.3	-	Hort	peak	100 kHz	Pass
4824	19.8	54.0	Vert/Hort	average	1 MHz	Pass
7236	-	54.0	Vert/Hort	average	1 MHz	Pass
9648	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12060	-	54.0	Vert/Hort	average	1 MHz	Pass
14472	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
16884	-	54.0	Vert/Hort	average	1 MHz	Pass

WLAN Transmitting on 2437 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2437	100.7	-	Hort	peak	100 kHz	Pass
4874	18.5	54.0	Vert/Hort	average	1 MHz	Pass
7311	-	54.0	Vert/Hort	average	1 MHz	Pass
9748	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12185	-	54.0	Vert/Hort	average	1 MHz	Pass
14622	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
17059	-	54.0	Vert/Hort	average	1 MHz	Pass

WLAN Transmitting on 2462 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2462	98.5	-	Hort	peak	100 kHz	Pass
4924	16.5	54.0	Vert/Hort	average	1 MHz	Pass
7386	-	54.0	Vert/Hort	average	1 MHz	Pass
9848	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12310	-	54.0	Vert/Hort	average	1 MHz	Pass
14772	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
17234	-	54.0	Vert/Hort	average	1 MHz	Pass

Where an average detector is listed in the above tables, measurements were also attempted using a peak detector where a limit of 74 dBuV/m was applied

Where an emission level is indicated by a –, levels had a margin greater than 20 dB when compared to the limit.

Other emissions observed when the device was operating in WLAN and Bluetooth modes with the GPS receiver on when powered at 110 Vac are detailed below.

Frequency	Level	Level	Limit	Margin	Result	Antenna
MHz	Vertical dBuV/m	Horizontal dBuV/m	dBuV/m	dB		Polarisation
30.000	28.6		40.0	11.4	Pass	Vertical
32.045	35.6		40.0	4.4	Pass	Vertical
33.453	34.0		40.0	6.0	Pass	Vertical
34.120	34.0		40.0	6.0	Pass	Vertical
35.345	31.0		40.0	9.0	Pass	Vertical
36.133	33.0		40.0	7.0	Pass	Vertical
37.543	31.0		40.0	9.0	Pass	Vertical
38.948	33.3		40.0	6.7	Pass	Vertical
39.678	28.3		40.0	11.7	Pass	Vertical
50.422	36.4		40.0	3.6	Uncert	Vertical
55.888	32.0		40.0	8.0	Pass	Vertical
56.653	32.2		40.0	7.8	Pass	Vertical
58.785	36.2		40.0	3.8	Uncert	Vertical
59.250	34.0		40.0	6.0	Pass	Vertical
60.228	36.2		40.0	3.8	Uncert	Vertical
60.803	34.0		40.0	6.0	Pass	Vertical
64.195	32.1		40.0	7.9	Pass	Vertical
64.768	34.0		40.0	6.0	Pass	Vertical
66.208	32.7		40.0	7.3	Pass	Vertical
66.758	29.2		40.0	10.8	Pass	Vertical
68.223	32.0		40.0	8.0	Pass	Vertical
68.450	35.3		40.0	4.7	Pass	Vertical
69.018	30.6		40.0	9.4	Pass	Vertical
70.850	34.7		40.0	5.3	Pass	Vertical
84.650	32.1		40.0	7.9	Pass	Vertical
111.600	30.0		43.5	13.5	Pass	Vertical
130.200	33.5		43.5	10.0	Pass	Vertical
135.358	32.2		43.5	11.3	Pass	Vertical
138.358	31.0		43.5	12.5	Pass	Vertical
141.226	32.1		43.5	11.4	Pass	Vertical
259.000		29.7	46.0	16.3	Pass	Horizontal
331.308		31.0	46.0	15.0	Pass	Horizontal
332.308		29.5	46.0	16.5	Pass	Horizontal
332.640	31.0		46.0	15.0	Pass	Vertical
366.300		29.0	46.0	17.0	Pass	Horizontal
416.000		27.5	46.0	18.5	Pass	Horizontal

Other emissions observed when the device was operating in WLAN and Bluetooth modes with the GPS receiver on when powered at 12 Vdc using the serial clip.

Frequency	Level	Level	Limit	Margin	Result	Antenna
MHz	Vertical dBuV/m	Horizontal dBuV/m	dBuV/m	dB		Polarisation
30.350	31.5		40.0	8.5	Pass	Vertical
38.250	25.0		40.0	15.0	Pass	Vertical
52.050	30.7		40.0	9.3	Pass	Vertical
63.900	34.6		40.0	5.4	Pass	Vertical
68.200	36.0		40.0	4.0	Uncert	Vertical
72.000	31.9		40.0	8.1	Pass	Vertical
72.000	31.4		40.0	8.6	Pass	Vertical
74.700	33.0		40.0	7.0	Pass	Vertical
132.610	32.3	28.4	43.5	11.2	Pass	Vertical
135.400	35.4		43.5	8.1	Pass	Vertical
144.000	31.6		43.5	11.9	Pass	Vertical
216.000	29.2		43.5	14.3	Pass	Vertical
240.000	29.0		46.0	17.0	Pass	Vertical
280.413	29.5		46.0	16.5	Pass	Vertical
288.000	25.0		46.0	21.0	Pass	Vertical
299.850	28.5		46.0	17.5	Pass	Vertical
300.448	30.1		46.0	15.9	Pass	Vertical
304.600	29.7		46.0	16.3	Pass	Vertical
312.000		32.3	46.0	13.7	Pass	Horizontal
331.500	38.6		46.0	7.4	Pass	Vertical
360.000		33.4	46.0	12.6	Pass	Horizontal
384.000		33.6	46.0	12.4	Pass	Horizontal
408.000		28.9	46.0	17.1	Pass	Horizontal
433.318	24.1		46.0	21.9	Pass	Vertical
480.000	27.8		46.0	18.2	Pass	Vertical
499.400	21.3		46.0	24.7	Pass	Vertical
582.400	31.0		46.0	15.0	Pass	Vertical
599.600	31.0		46.0	15.0	Pass	Vertical
608.000	30.3		46.0	15.7	Pass	Vertical

Emissions with a margin greater than 20 dB of the limit have not been reported.

When the device was powered at 110 Vac the following devices were connected:
- external GPS antenna to that GPS antenna port
- laptop computer to the Ethernet port
- USB device attached to the USB port

The device could also be powered using an external 12 Vdc source using what is known as a serial clip.

When using the serial clip the following devices were connected:
- external GPS antenna to that GPS antenna port
- laptop computer to the serial port
- 12 Vdc in car power supply adaptor

The standard limits have been applied to the other emissions below 1000 MHz as these emissions are always present and are not determined by whether the transmitter is on or not.

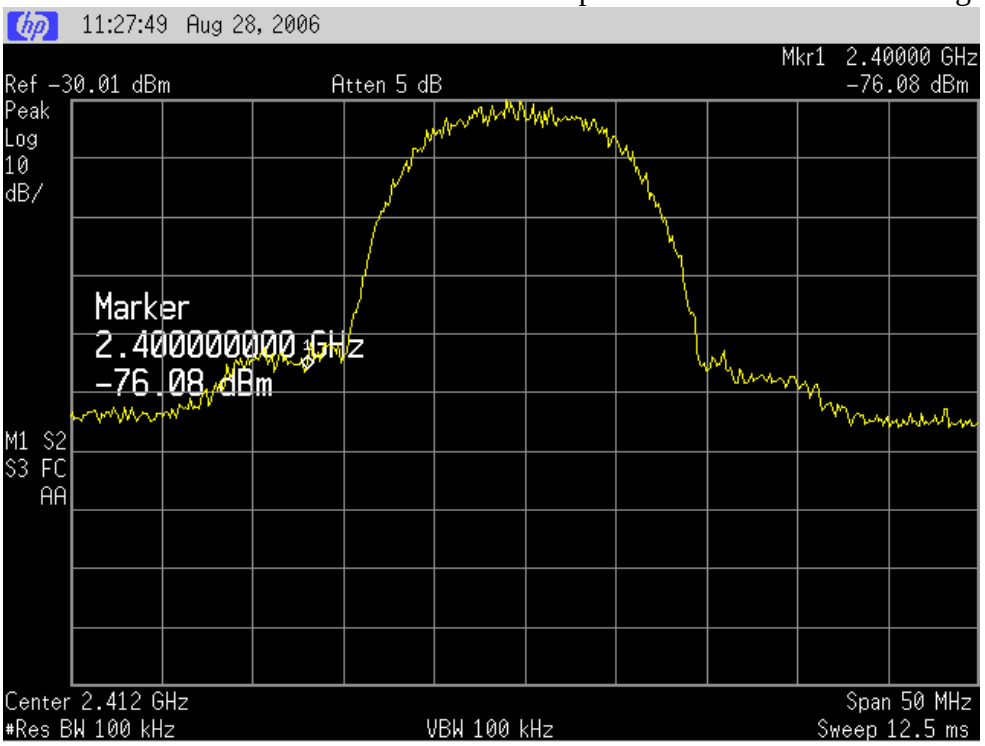
Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 18,000 MHz) ± 4.1 dB

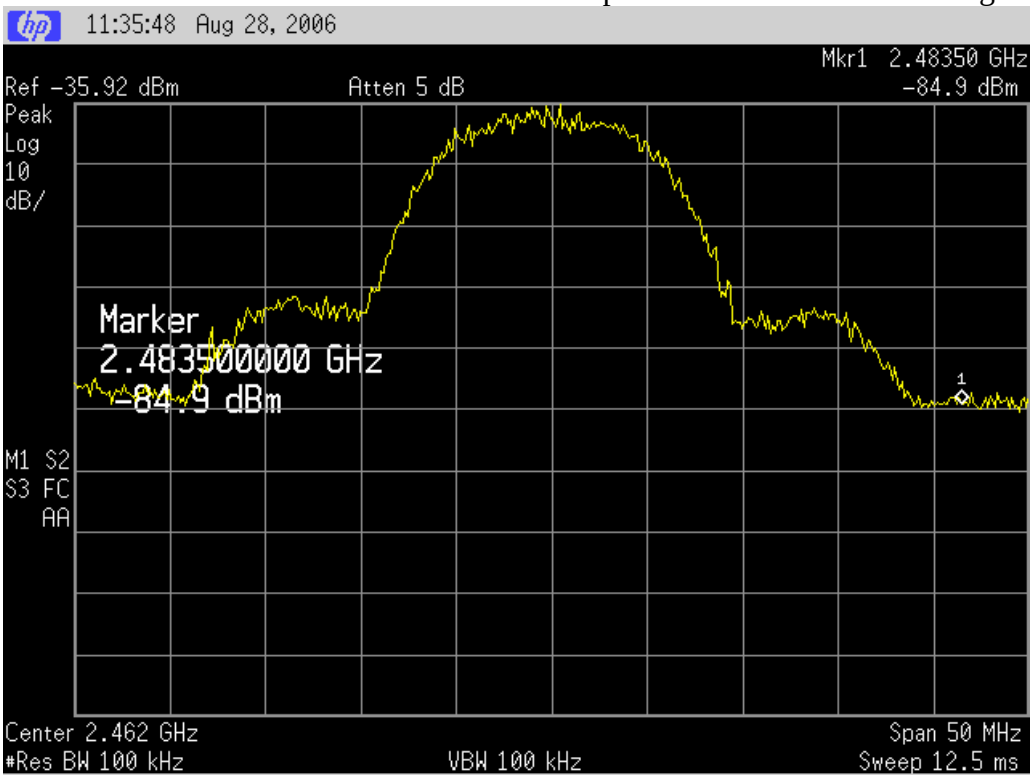
Band edge measurements

The WLAN device is required to operate in the band 2400 MHz to 2483.5 MHz

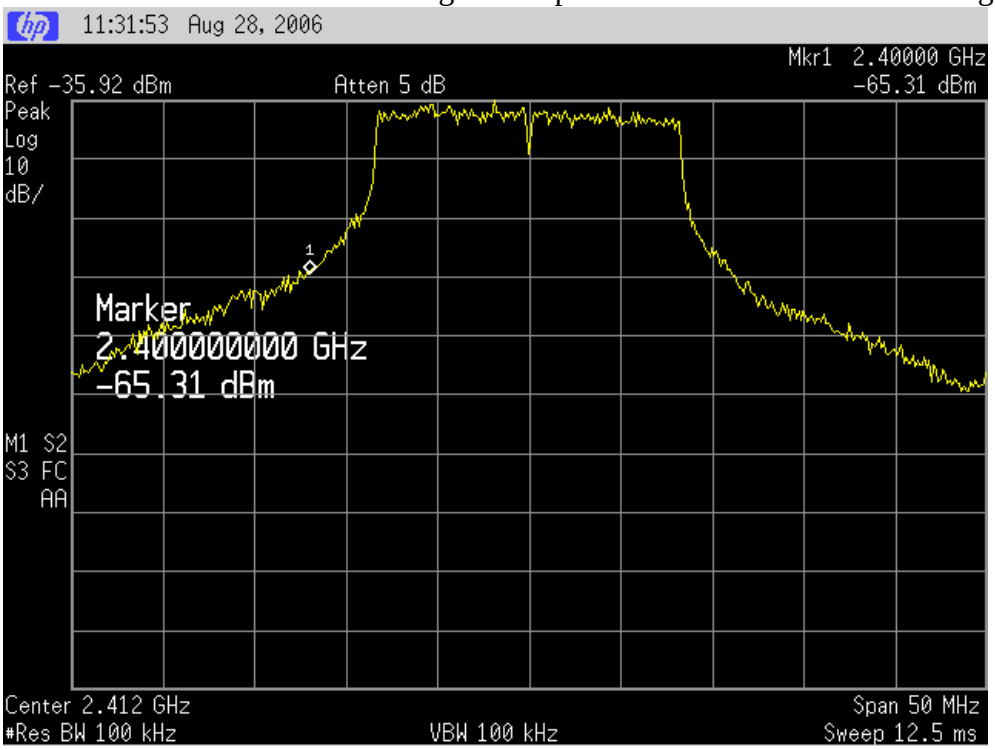
WLAN mode on 2412 MHz. 802.11b. 11 Mbps. -46.1 dB down at band edge



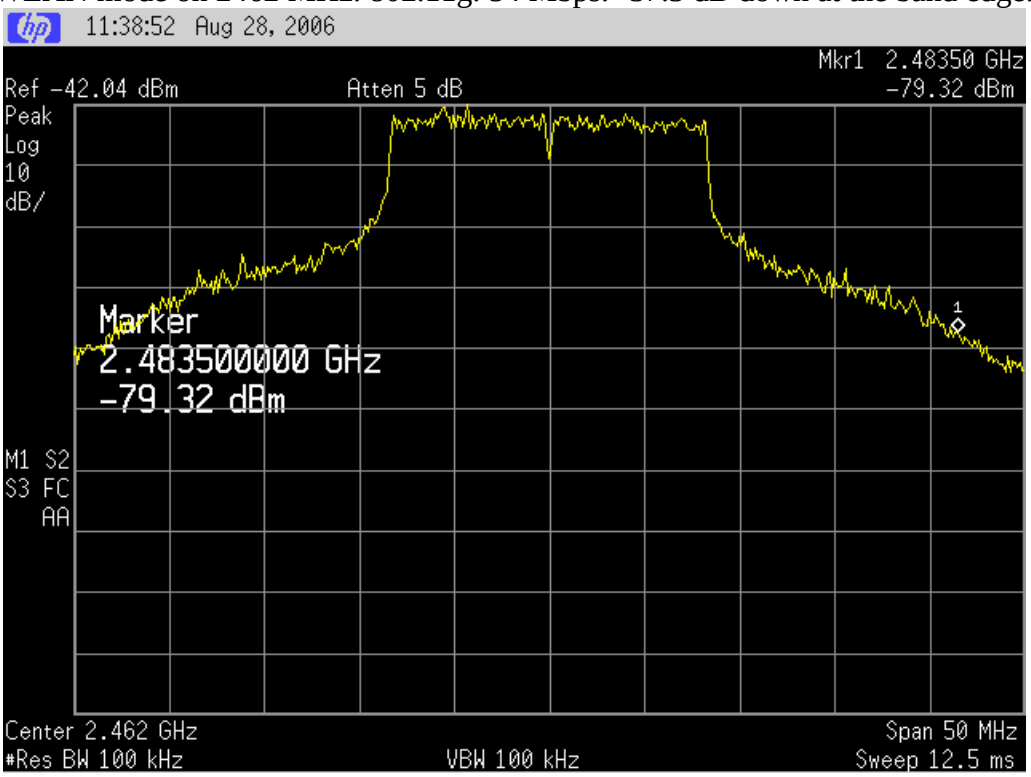
WLAN mode on 2462 MHz. 802.11b. 11 Mbps. -49.0 dB down at band edge



WLAN mode on 2412 MHz. 802.11g. 54 Mbps. -29.4 dB down at the band edge.



WLAN mode on 2462 MHz. 802.11g. 54 Mbps. -37.3 dB down at the band edge.



Test site measurements were in the 2310 – 2390 MHz and 2483.5 – 2500 MHz restricted bands using a peak detector and an average detector with a 1 MHz bandwidth.

Restricted band 2310 – 2390 MHz

Operating Frequency MHz	Mode	Data Rate (Mbps)	Highest Level dBuV/m	Limit dBuV/m	Detector	Result
2412.0	802.11a	1.0	41.4	54.0	Average	Pass
2412.0	802.11a	5.5	41.4	54.0	Average	Pass
2412.0	802.11a	11.0	41.4	54.0	Average	Pass
2412.0	802.11g	6.0	41.4	54.0	Average	Pass
2412.0	802.11g	12.0	41.2	54.0	Average	Pass
2412.0	802.11g	24.0	41.4	54.0	Average	Pass
2412.0	802.11g	54.0	41.4	54.0	Average	Pass

Restricted band 2483.5 – 2500.0 MHz

Operating Frequency MHz	Mode	Data Rate (Mbps)	Highest Level dBuV/m	Limit dBuV/m	Detector	Result
2462.0	802.11g	54.0	43.5	54.0	Average	Pass

Result: Complies

Section 15.247 (e) – Peak power spectral density

As the transmitter does not have an external antenna port radiated measurements were made at the open area test site.

The device was placed on the test table, being 80 cm above the ground plane, with the device facing the test antenna located 3 metres away.

The device was rotated in order to determine the highest power output indication.

Measurements were made with the spectrum analyser operating in peak hold mode with a resolution bandwidth of 3 kHz.

Measurements were made as follows:

Frequency MHz	Mode	Data Rate (Mbps)	Level dBm	Limit dBm	Result
2412.0	802.11a	1.0	-25.2	8.0	Pass
2412.0	802.11a	5.5	-17.9	8.0	Pass
2412.0	802.11a	11.0	-17.0	8.0	Pass
2412.0	802.11g	6.0	-26.3	8.0	Pass
2412.0	802.11g	12.0	-24.3	8.0	Pass
2412.0	802.11g	24.0	-22.4	8.0	Pass
2412.0	802.11g	54.0	-21.9	8.0	Pass
2462.0	802.11a	11.0	-20.2	8.0	Pass
2462.0	802.11g	54.0	-28.6	8.0	Pass

The specification limit is 8 dBm in any 3 kHz band during a continuous transmission.

Result: Complies.

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Ref No
Aerial Controller	EMCO	1090	9112-1062	3710
Aerial Mast	EMCO	1070-1	9203-1661	3708
Turntable	EMCO	1080-1-2.1	9109-1578	3709
VHF Balun	Schwarzbeck	VHA 9103	-	3603
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612
Log Periodic Antenna	Schwarzbeck	VUSLP 9111	9111-228	3785
Measurement Receiver	Rohde & Schwarz	ESCS 30	839873/1	E1595
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776
Coax Cable	Sucoflex	104PA	2736/4PA	-
Horn Antenna	EMCO	3115	9511-4629	E1526
Horn Antenna	Electrometrics	RGA -60	6234	E1494
Microwave Amplifier	Hewlett Packard	8349B	2644A01659	-

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated on February 17th, 2004.

In addition testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ISO 17025.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/IEC/ISO 17025.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 46 accreditation bodies in 34 economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.