

EMC Technologies (NZ) Ltd

Test Report No 60819.4

Report date: 11 September 2006

TEST REPORT

Trimble Geo Explorer 2005 Handheld GPS with Bluetooth Transmitter Module

tested to the

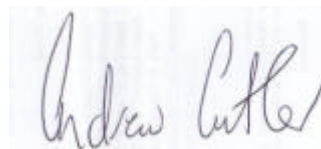
Code of Federal Regulations (CFR) 47

**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

EMC Technologies (NZ) Ltd

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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 Blue Tooth Module
Manufacturer	Trimble Navigation NZ Ltd
Country of Origin	New Zealand
Serial Number	4537461959
FCC ID	JUP613

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3. COMPLIANCE STATEMENT

The Trimble Geo Explorer 2005 Handheld GPS with Bluetooth

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.

<u>CLAUSE</u>	<u>TEST PERFORMED</u>	<u>RESULT</u>
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	Complies
(a)(1)(iii)	FHSS channel occupancy	Complies
(a)(2)	Digital modulation bandwidth	Not applicable
(b)(1)	FHSS peak output power	Complies
(b)(3)	Digital peak output power	Not applicable
(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

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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 Bluetooth transmitter to enable the device to communicate with other computing devices using wireless technology.

Modulation system used

Bluetooth: Frequency hopping spread spectrum (GFSK) at 1 Mbps

Rated Module Output Power

Bluetooth: 2.5 dBm

Antenna Type

Bluetooth: Mica SMD made by GigaAnt (P/N 3030A5645-01)

Test frequencies

Bluetooth: 2402 MHz, 2440 MHz, 2480 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.

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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.

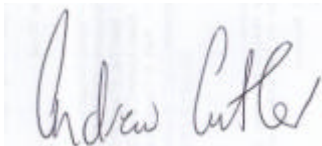
This report does not contain corrections or erasures.

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

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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 Quad 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) \pm 2.2 dB

Result: Complies

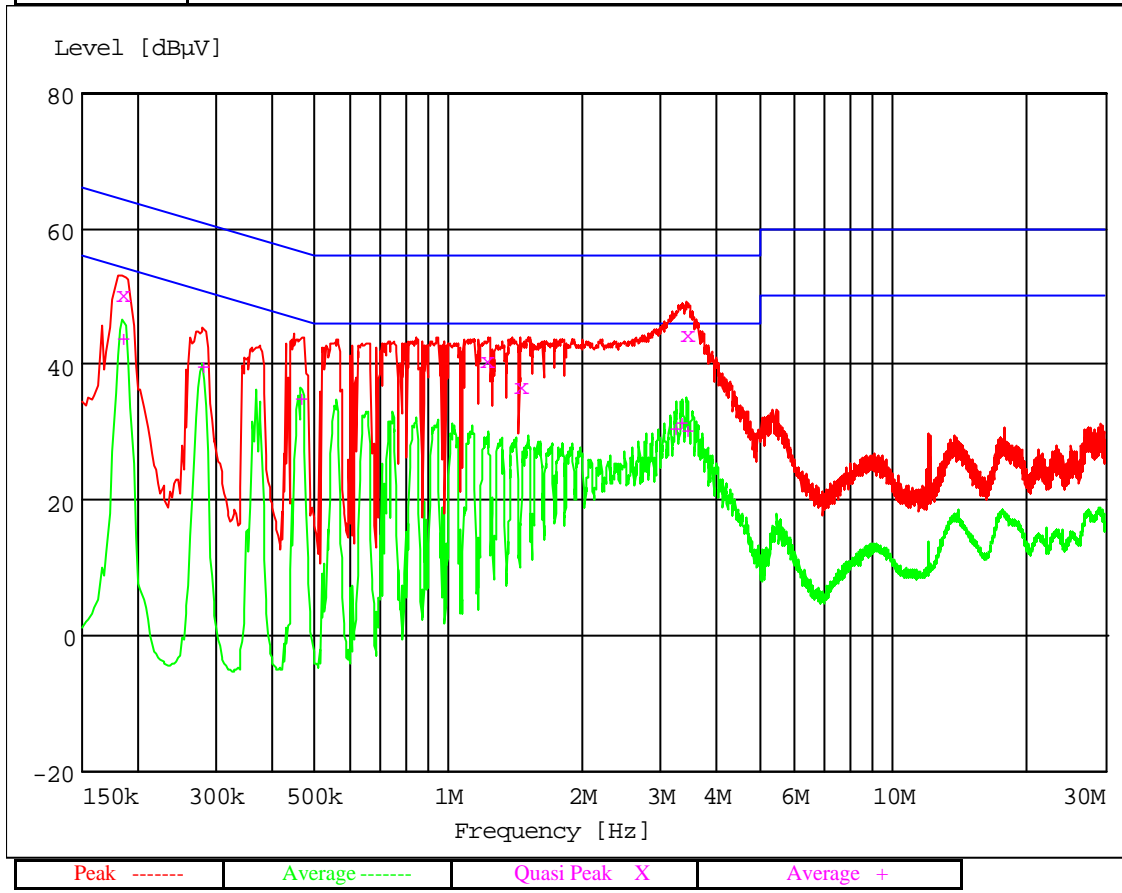
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Conducted emissions

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



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	

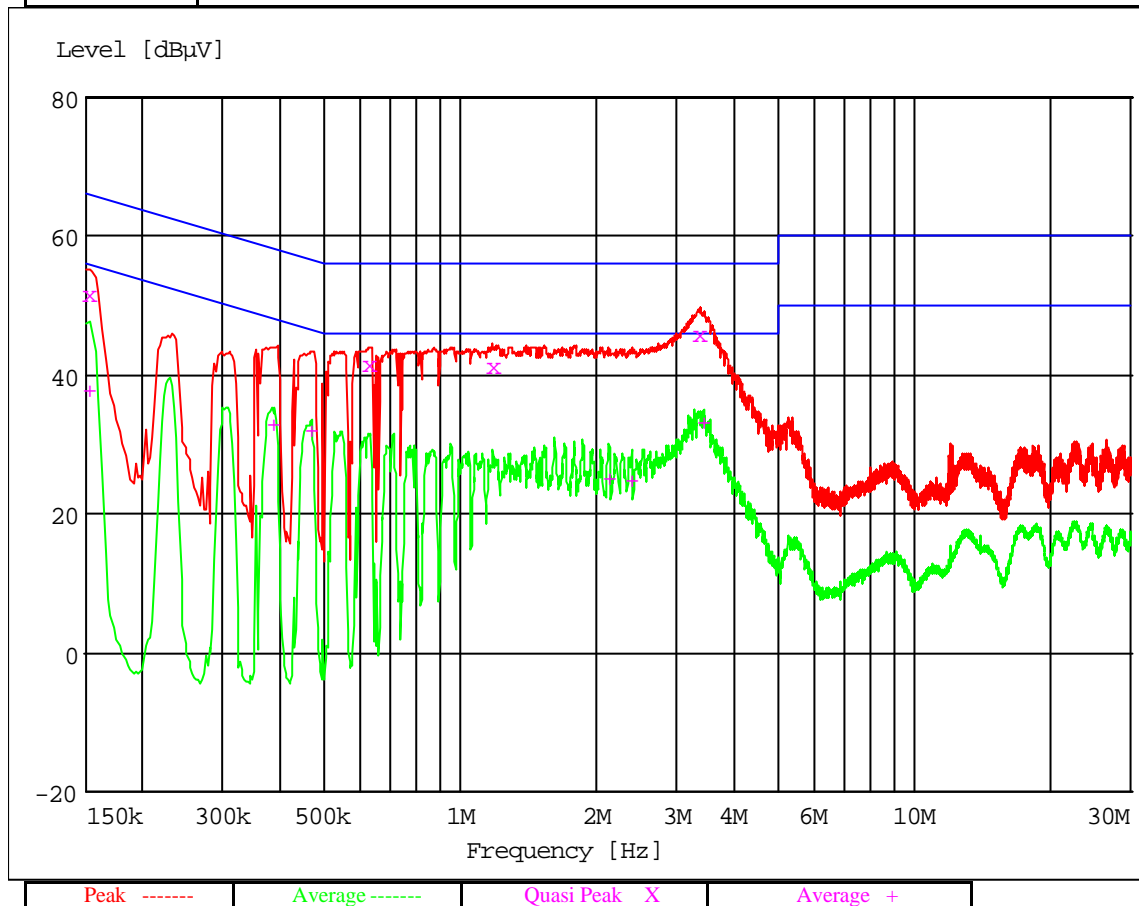
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Conducted emissions

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

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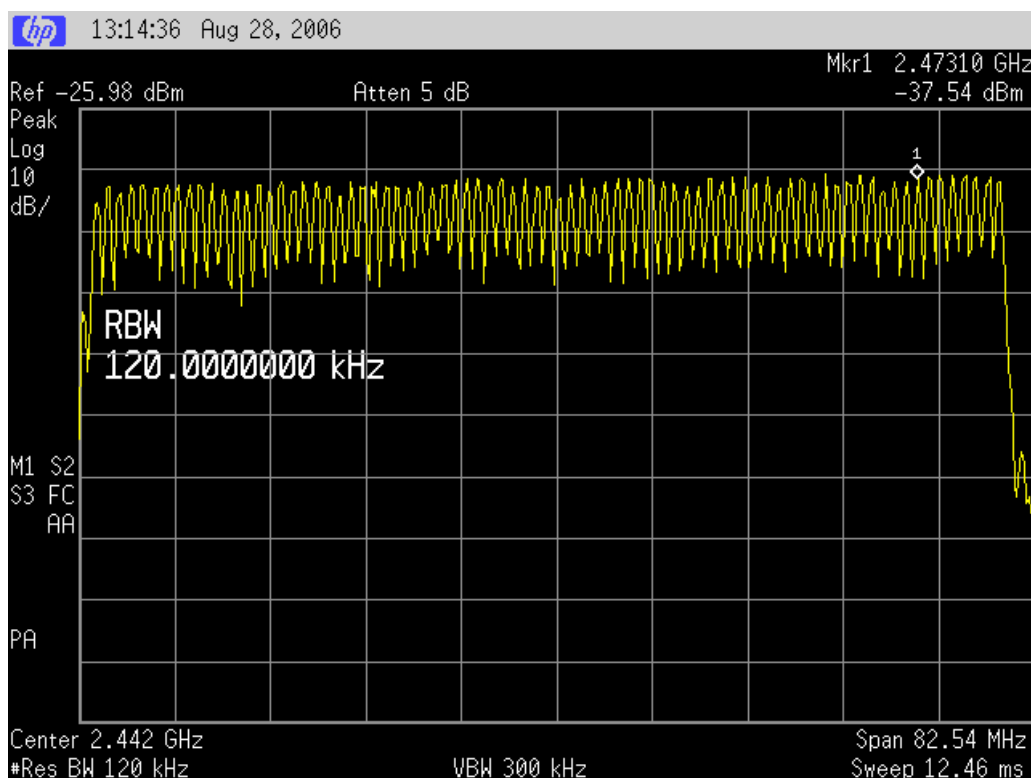
Section 15.209 – Radiated emissions

In accordance with section 15.247(c) attenuation below the general limits specified in Section 15.209(a) is not required except for those emissions that fall within the restricted bands defined in Section 15.205(a).

Section 15.247 (a) (1) – Frequency hopping systems channel bandwidth.

The frequency hopping system tested was a Bluetooth device.

79 channels were observed in operation between 2402 MHz and 2480 MHz which equates to a channel spacing of 1 MHz.



The 20 dB bandwidth has been determined at 2402 MHz, 2440 MHz and 2480 MHz using a spectrum analyser with a resolution bandwidth of 30 kHz that gave a worst case bandwidth of 863 kHz.

Testing was carried out using the test option where by a continuous stream of packet was sent using a PRBS9 data sequence.

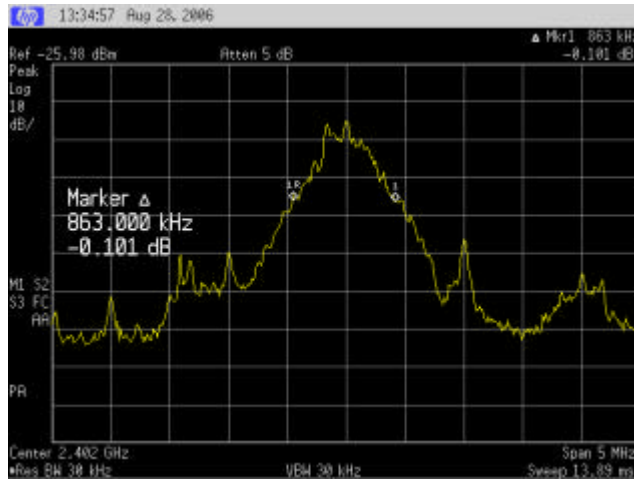
This approximates the calculated channel spacing of 1 MHz.

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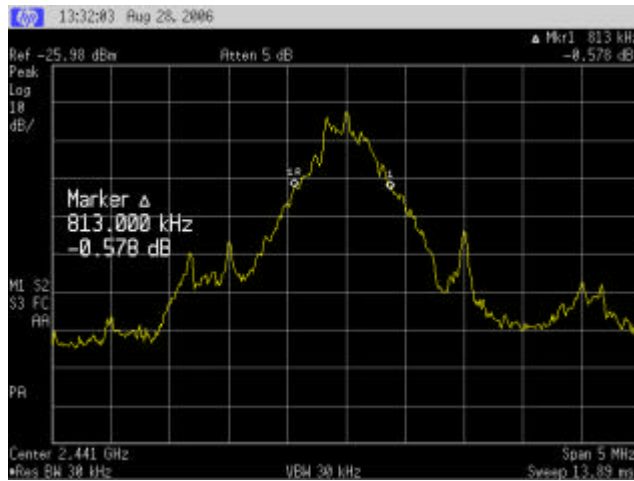
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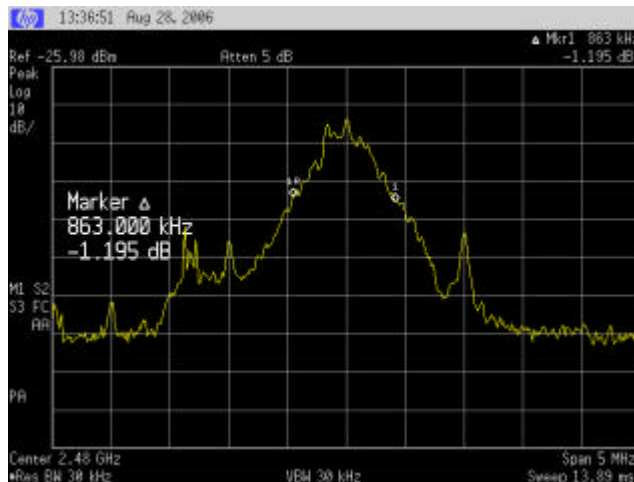
2402 MHz 20 dB bandwidth



2441 MHz 20 dB bandwidth



2480 MHz 20 dB bandwidth



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Channel spacing when hopping



Section 15.247 (a) (1) (iii) – Channel occupancy

As detailed previously 79 channels are used between 2402 – 2480 MHz.

The average time of occupancy on any channel shall not exceed 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels utilised.

$400 \text{ mS} \times 79 \text{ channels} = 31.5 \text{ seconds.}$

The Bluetooth specification states that each channel is occupied for 625 μs during which time any data is transmitted and received.

The device was operated using test software supplied by the client.

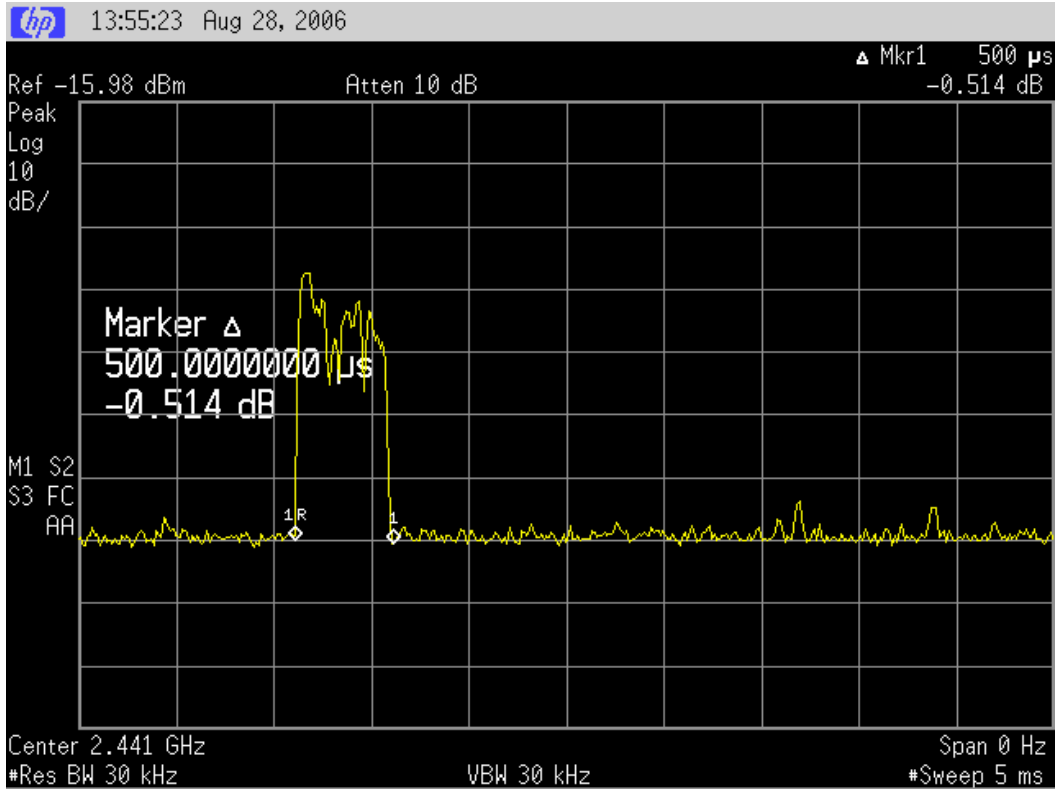
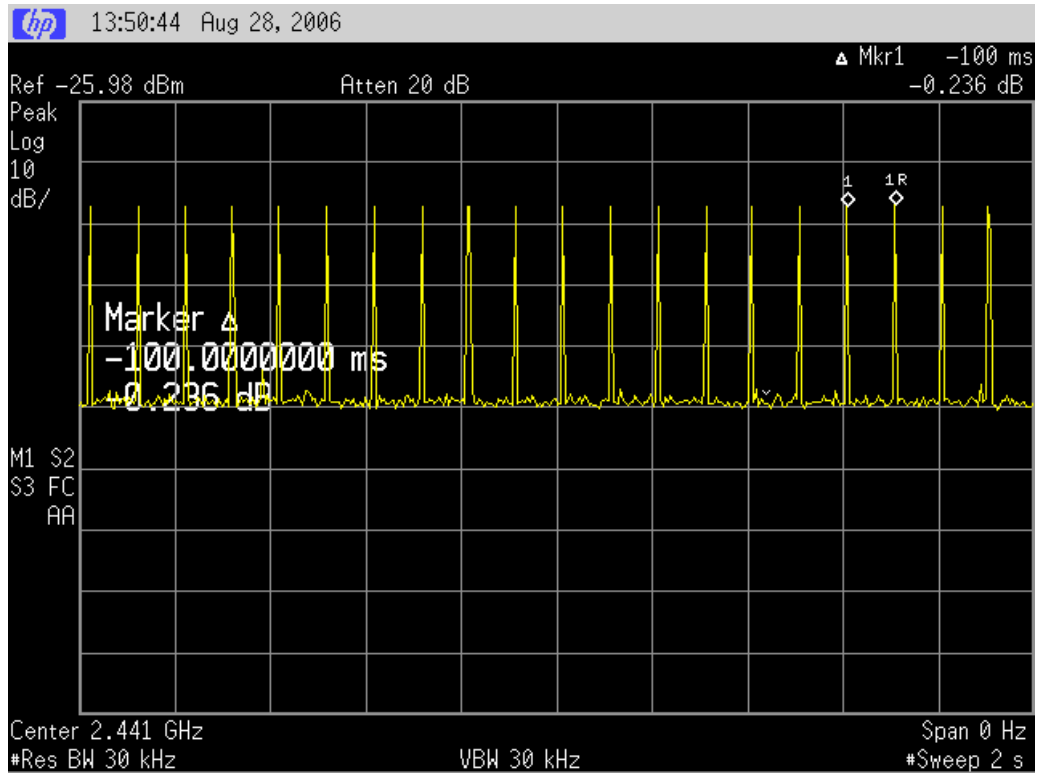
When tuned to 2441 MHz with a 0 Hz span the transmitter was observed to operate 20 times in 2 seconds.

Therefore in a 31.5 second period the transmitter would operate 315 times.

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It can be seen that the transmitter operates for approximately 500 uS of the 625 uS.

As per the Bluetooth specification, in any observation period the transmitter will operate on one channel for up to 625 uS and then hop to the next channel to receive for up to 625 uS and then hop to the next channel to transmit for a further 625 uS etc.

In any 31.5 second period the transmitter will transmit 315 times and the receiver will receive 315 times on the channel where observations are made.

The channel will therefore have been occupied a total of 630 times.

In a period of 31.5 seconds each channel was occupied on average for a period of:

$630 \text{ times} \times 625 \text{ uS} = 0.39375 \text{ seconds}$ or 393.75 mS.

The specification limit is 0.4 seconds or 400 mS in a 31.5 second observation period.

Result: Complies

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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.

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Measurements of the Bluetooth device were made with the spectrum analyser operating in peak hold mode with a resolution bandwidth of 1 MHz when transmitting continuously on selected channels.

Measurements were made on a low, middle and high frequency channel

Frequency MHz	Level dBm	Limit dBm	Result
2402.0	-7.3	30.0	Pass
2440.0	-5.4	30.0	Pass
2480.0	-3.6	30.0	Pass

The specification limit is 30 dBm (1.0W).

Variation by $\pm 10\%$ of the supply voltage to the charger base did not vary the output power observed.

Result: Complies.

Section 15.247 (i) – Radio Frequency Hazard Information

As this is a portable device that is normally used close to the body SAR measurements have been carried by EMC Technologies Pty Ltd.

Reference should be made to the test report that details these measurements

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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.

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

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Bluetooth Transmitting on 2402 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2402	87.7	-	Vert	peak	100 kHz	Pass
4804	26.5	54.0	Vert/Hort	average	1 MHz	Pass
7206	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
9608	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12010	-	54.0	Vert/Hort	average	1 MHz	Pass
14412	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
16814	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass

Bluetooth Transmitting on 2440 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2440	89.6	-	Vert	peak	100 kHz	Pass
4880	28.5	54.0	Vert/Hort	average	1 MHz	Pass
7320	-	54.0	Vert/Hort	average	1 MHz	Pass
9760	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12200	-	54.0	Vert/Hort	average	1 MHz	Pass
14640	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
17080	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass

Bluetooth Transmitting on 2480 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m (dB)	Antenna Pol	Detector	Bandwidth	Result
2480	91.5	-	Vert	peak	100 kHz	Pass
4960	29.6	54.0	Vert/Hort	average	1 MHz	Pass
7440	23.6	54.0	Vert/Hort	average	1 MHz	Pass
9920	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
12400	-	54.0	Vert/Hort	average	1 MHz	Pass
14880	-	(-20.0)	Vert/Hort	peak	100 kHz	Pass
17360	-	(-20.0)	Vert/Hort	peak	100 kHz	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.

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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 MHz	Level	Level	Limit dBuV/m	Margin dB	Result	Antenna Polarisation
	Vertical dBuV/m	Horizontal dBuV/m				
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

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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 MHz	Level	Level	Limit dBuV/m	Margin dB	Result	Antenna Polarisation
	Vertical dBuV/m	Horizontal dBuV/m				
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

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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) \pm 4.1 dB

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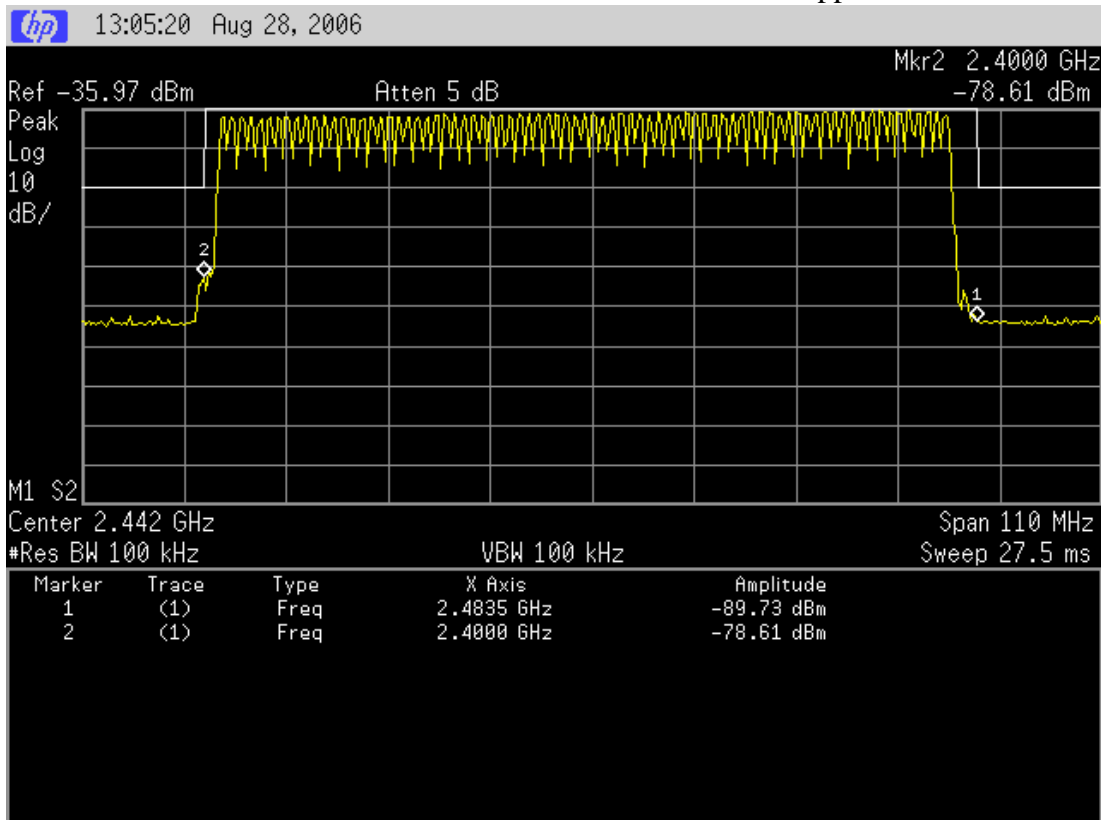
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Band edge measurements

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

Initially relative measurements were made in the laboratory using a 100 kHz resolution bandwidth with the -20 dB limit being applied at both band edges.

Blue tooth mode between 2402 – 2480 MHz with a 20 dB mask applied.



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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
2404.0	Bluetooth	-	41.0	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
2480.0	Bluetooth	-	42.2	54.0	Average	Pass

Result: Complies

EMC Technologies (NZ) Ltd

Test Report No 60819.4

Report date: 11 September 2006

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.