

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

TEST REPORT

Commtest Ranger Base Station

tested to

47 Code of Federal Regulations

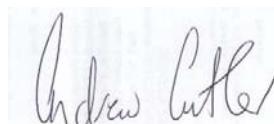
Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

Section 15.247 – Operation in the band 2400 – 2483.5 MHz

for

Commtest Instruments 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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Page 1 of 32

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Test Report No **091216.10**

Report date: 14 April 2010

Table of Contents

1. STATEMENT OF COMPLIANCE	3
2. RESULTS SUMMARY	3
3. INTRODUCTION	4
4. CLIENT INFORMATION	4
5. DESCRIPTION OF TEST SAMPLE	4
6. SETUPS AND PROCEDURES	6
7. TEST EQUIPMENT USED	27
8. ACCREDITATIONS	27
9. PHOTOGRAPHS	28

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Test Report No **091216.10**

Report date: 14 April 2010

1. STATEMENT OF COMPLIANCE

The **Commtest Instruments Ranger Base Station** complies with FCC Part 15 Subpart C as an Intentional Radiator when the methods as described in ANSI C63.4 - 2003 are applied.

2. RESULTS SUMMARY

The results from testing are summarised in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required
15.203	Antenna requirement	Complies
15.204	External PA and antenna modifications	Complies
15.205	Restricted bands of operation	Complies
15.207	Conducted limits	Complies
15.209	Radiated emission limits	Complies
15.247		
(a)(2)	Minimum 6 dB bandwidth	Complies
(b)(3)	Peak output power	Complies
(c)	Directional antenna gains greater than 6 dBi	Not applicable
(d)	Out of band emissions	Complies
(e)	Power spectral density	Complies
(f)	Hybrid systems	Not applicable
(g)	Use of all channels	Not applicable
(h)	Intelligent frequency hopping	Not applicable
(i)	Radio frequency hazards	Complies

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Test Report No **091216.10**

Report date: 14 April 2010

3. INTRODUCTION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification.

The client selected the test sample.

This report relates only to the sample tested.

This report contains no 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.

4. CLIENT INFORMATION

Company Name	Commtest Instruments Ltd
Address	PO Box 9297
City	Christchurch 8243
Country	New Zealand
Contact	Mr Brian Wood

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Commtest
Model Number	Ranger
Product	Base Station
Manufacturer	Commtest Instruments Ltd
Country of Origin	New Zealand
Serial Number	6002, 6012
FCC ID	V92RGST

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Test Report No **091216.10**

Report date: 14 April 2010

Device description

This base station forms part of a wireless sensor system.

It creates a link between a wireless sensor and a monitoring system, typically a computer, using a 2.4 GHz Zigbee link between the sensor and the base station using either an Ethernet connection or a 2.4 GHz wireless LAN connection between the base station and the computer.

The RF communications are driven by the CC2430 microprocessor and under normal operations the device will send a MAC acknowledgement response to any packets received.

A low noise amplifier (LNA) and power amplifier stages are included within the device to ensure maximum range is achieved. The LNA is driven by a MAX2644 and the PA by a MAX2242.

Testing was carried out using a supplied EMC tester programme which established a link between a supplied sensor and a computer.

Testing was carried out using the Ethernet connection and also the Wireless LAN connection.

For testing purposes a representative AC power supply was used to supply 12 Vdc to the device with the tachometer connector being attached to a low impedance earth.

The WLAN transmitter has modular compliance with FCC ID: R68WIPORTG

Certification is being sought for the Zigbee transmitter.

Verification testing was carried out on the WLAN modular transmitter.

The device is capable of operating between 2400 – 2483.5 MHz in 5 MHz steps.

Testing has therefore been carried out at 2405 MHz, 2440 MHz and 2460 MHz.

IEEE 802.15.4 using Direct Sequence Spread Spectrum (DSSS) with CSMA and OQPSK modulation is used.

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

6. SETUPS AND PROCEDURES

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C and in particular section 15.247

Methods and Procedures

The measurement methods and procedures as described in ANSI C63.4 - 2003 were used.

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device as it contains a transmitter.

Certification is therefore sought for the Zigbee transmitter but the client advises that the WLAN transmitter is an FCC compliant module.

Verification testing has been carried out on the WLAN transmitter.

Section 15.203: Antenna requirement

This device has two external antennas.

The connectors for these antennas are required to be unique.

The antennas use reverse SMA connectors which are unique

Result: Complies

Section 15.204: External radio frequency power amplifiers and antenna modifications

An external power amplifier is not supplied with this device.

The equipment manual contains a warning about modifications to the device including the antennas.

Result: Complies.

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Section 15.205: Restricted bands of operation

The transmitters contained within this device operate in the 2400 – 2483.5 MHz band which is covered by Section 15.247.

Result: Complies.

Section 15.207: Conducted emissions testing

Conducted Emissions testing was carried out over the frequency range of 150 kHz to 30 MHz which was carried out at the laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room

Testing was carried out using a representative AC adaptor as this can be connected to the AC mains supply either directly or indirectly.

The transmitters in this device operate in the 2400 – 2483.5 MHz band.

Testing was carried out when the device was operating with a LAN connection and with a WLAN connection with a remote sensor being addressed periodically using a test programme supplied by the client

The device was placed on top of the emissions table, which is 1 m x 1.5 m, 80 cm 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 80 cm from the artificial mains network.

The Class B limits have been applied.

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- AC Mains port (0.15-30 MHz) \pm 2.8 dB

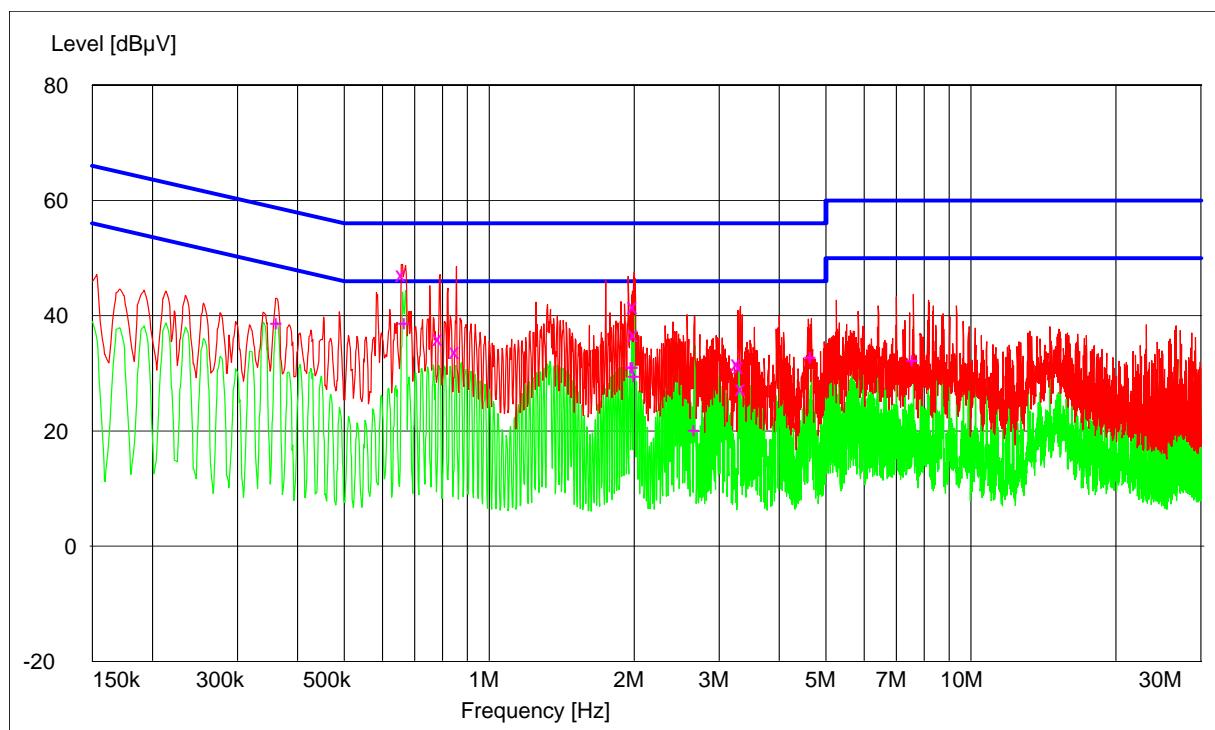
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Report date: 14 April 2010

Conducted Emissions – AC Mains Port

Setup:	Device serial number 60002 tested when transmitting and receiving continuously with a remote sensor when powered at 115 Vac while using an AC adaptor.
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Quasi-Peak Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Phase	Rechecks dB μ V
0.660000	47.20	56.0	8.9	L1	
0.789000	36.10	56.0	19.9	N	
0.855000	33.90	56.0	22.1	N	
1.998000	41.60	56.0	14.4	L1	
2.004500	36.80	56.0	19.2	N	
3.278000	31.60	56.0	24.4	N	
3.318500	31.10	56.0	24.9	N	

Average Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Phase	Rechecks dB μ V
0.363000	38.90	49.0	9.8	L1	
0.669000	38.90	46.0	7.1	L1	
1.977000	31.10	46.0	14.9	L1	
1.992000	31.20	46.0	14.8	L1	
2.004500	29.60	46.0	16.5	L1	
4.664000	32.90	46.0	13.1	L1	
7.584500	32.40	50.0	17.6	L1	

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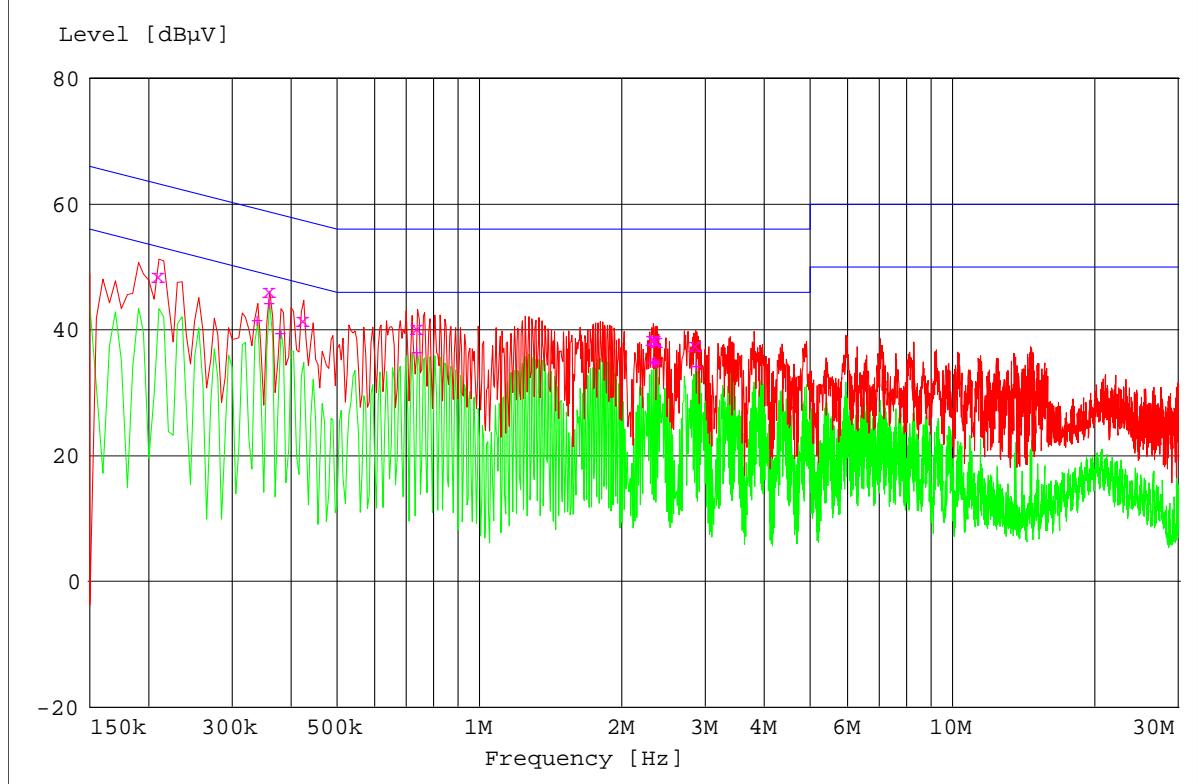
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Test Report No **091216.10**

Report date: 14 April 2010

Conducted emissions – AC Mains Port

Comments:	Device tested when powered at 120 Vac when operating in WLAN mode
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Peak -----	Average -----	Quasi Peak X	Average +
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Quasi-Peak Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Phase	Rechecks dB μ V
0.210000	48.60	63.2	14.5	L1	
0.360000	46.30	58.7	12.3	L1	
0.425000	41.60	57.3	15.6	L1	
0.740000	40.40	56.0	15.5	L1	
2.330000	38.70	56.0	17.2	L1	
2.350000	38.70	56.0	17.2	L1	
2.370000	38.30	56.0	17.7	L1	
2.860000	37.70	56.0	18.2	L1	

Average Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Phase	Rechecks dB μ V
0.340000	41.60	49.2	7.5	L1	
0.360000	44.40	48.7	4.3	L1	43.5
0.380000	39.50	48.2	8.7	L1	
0.740000	36.50	46.0	9.4	L1	
2.330000	35.00	46.0	10.9	L1	
2.350000	35.10	46.0	10.8	L1	
2.370000	34.70	46.0	11.2	L1	
2.880000	34.40	46.0	11.5	L1	

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Test Report No **091216.10**

Report date: 14 April 2010

Section 15.209: Radiated emission limits, general requirements

Radiated emissions testing was carried out over the frequency range of 30 MHz to 24 GHz as the device operates in the 2.4 GHz band and contains a number of clock oscillators.

Testing was carried out at the laboratory's open area test site - located at Driving Creek, Orere Point, Auckland, New Zealand.

Testing was carried out when the device was operating in LAN and WLAN modes.

A number of the 25 MHz and 50 MHz emissions observed were from the laptop computer have been recorded to show compliance of the device when attached to a computer using an Ethernet connection.

Measurements between 30 – 24,000 MHz have been made at a distance of 3 metres.

A receiver with a quasi peak detector with a 120 kHz bandwidth was used between 30 – 1000 MHz and between 1000 – 24,000 MHz a peak detector and an average detector were used.

The spurious emissions observed do not exceed the level of the fundamental emission.

The limits as described in Section 15.209 have been applied.

This site conforms to the requirements of CISPR 16 and ANSI C63.4 - 2003.

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, where appropriate, with an automated antenna tower.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations, where appropriate.

The emission level was 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)

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 24,000 MHz) \pm 4.1 dB

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Radiated Emissions – Ethernet and WLAN mode

The device was tested laying flat on the test table with the WLAN and Remote antennas vertically upright.

The device was powered at 12 Vdc using an external DC power supply.

Attached to the device was a laptop computer that was attached to the Ethernet port

Testing was carried out using an EMC test programme that established a continuous link with a sensor that was placed approximately 20 metres after that was operating on 2440 MHz.

Testing was also carried out using the EMC test programme with a WLAN link established with the laptop computer that no longer attached to the Ethernet port but was placed 20 metres away from the device under test.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
30.580	32.9		40.0	7.1	Quasi Peak	Vertical
58.695	32.7	34.5	40.0	5.5	Quasi Peak	Horizontal
60.225	34.5		40.0	5.5	Quasi Peak	Vertical
66.250	33.1		40.0	6.9	Quasi Peak	Vertical
125.000		27.9	43.5	12.1	Quasi Peak	Horizontal
141.233		38.1	43.5	1.9	Quasi Peak	Horizontal
142.698	34.1		43.5	9.4	Quasi Peak	Vertical
143.245	35.8	38.7	43.5	4.8	Quasi Peak	Horizontal
144.710	34.0		43.5	9.5	Quasi Peak	Vertical
145.263	36.5		43.5	7.0	Quasi Peak	Vertical
145.325	34.8		43.5	8.7	Quasi Peak	Vertical
145.810	32.1		43.5	11.4	Quasi Peak	Vertical
148.130		38.6	43.5	4.9	Quasi Peak	Horizontal
151.613		35.6	43.5	7.9	Quasi Peak	Horizontal
157.598		32.1	43.5	11.4	Quasi Peak	Horizontal
166.250	31.5		43.5	12.0	Quasi Peak	Vertical
172.803	29.8		43.5	13.7	Quasi Peak	Vertical
177.725	28.0		43.5	15.5	Quasi Peak	Vertical
192.000	32.5	37.6	43.5	5.9	Quasi Peak	Horizontal
225.000	31.2	37.4	43.5	6.2	Quasi Peak	Horizontal
240.000		32.7	46.0	13.3	Quasi Peak	Horizontal
250.000	37.4	43.0	46.0	3.0	Quasi Peak	Horizontal
275.000		38.9	46.0	7.1	Quasi Peak	Horizontal
314.203	36.0		46.0	10.0	Quasi Peak	Vertical
324.998	29.5		46.0	16.5	Quasi Peak	Vertical
350.000	31.8		46.0	14.2	Quasi Peak	Vertical

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Radiated Emissions Continued – Ethernet and WLAN mode

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
375.000	33.8	43.6	46.0	2.4	Quasi Peak	Horizontal
400.000	35.5	43.6	46.0	2.4	Quasi Peak	Horizontal
450.000	38.7	45.0	46.0	1.0	Quasi Peak	Horizontal
500.000	37.8		46.0	9.2	Quasi Peak	Vertical
550.000	40.4	46.0	46.0	0.0	Quasi Peak	Horizontal
600.000	43.4	44.4	46.0	1.6	Quasi Peak	Horizontal
625.000	39.1		46.0	6.9	Quasi Peak	Vertical
650.000	44.4	44.4	46.0	1.6	Quasi Peak	Vertical
700.000	46.0	44.4	46.0	0.0	Quasi Peak	Vertical
725.000	39.6	42.8	46.0	3.2	Quasi Peak	Horizontal
750.000	44.9	44.4	46.0	1.1	Quasi Peak	Vertical
775.000	39.3	41.0	46.0	5.0	Quasi Peak	Horizontal
800.000		40.0	46.0	6.0	Quasi Peak	Horizontal
951.000		41.9	46.0	4.1	Quasi Peak	Horizontal
975.000		44.1	46.0	1.9	Quasi Peak	Horizontal

No further general emissions detected from this device when measurements were attempted up to 24 GHz when using either vertical or horizontal polarisations.

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Test Report No **091216.10**

Report date: 14 April 2010

Section 15.247(a)(2): Minimum bandwidth

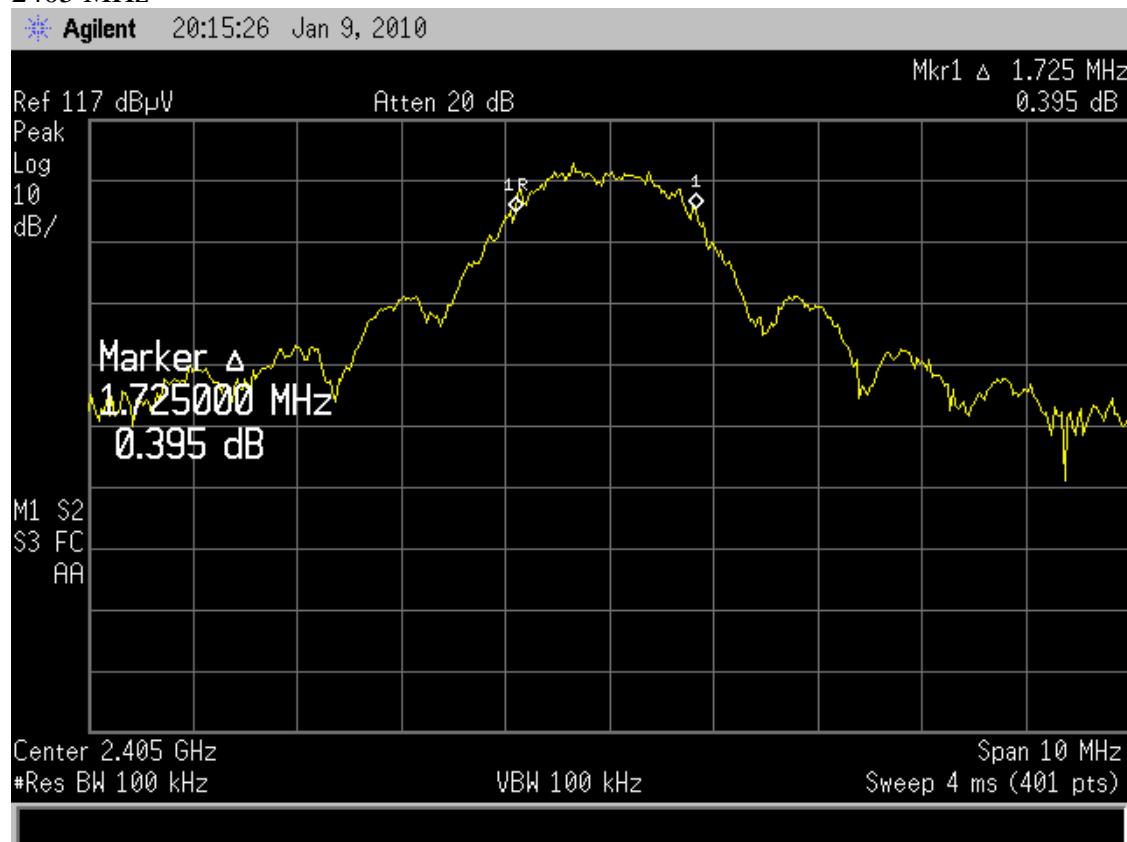
Systems using digital modulation techniques shall have a minimum 6 dB bandwidth of 500 kHz

Testing was carried on 2405 MHz, 2440 MHz and 2480 MHz with the following results:

Frequency (MHz)	6 dB bandwidth (MHz)
2405.000	1.7250
2440.000	1.6500
2460.000	1.6500

Result: Complies

2405 MHz



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Report date: 14 April 2010

2440 MHz



2460 MHz



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Report date: 14 April 2010

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

Radiated peak power measurements were made as the antenna port could not be easily accessible due to the use of reverse SMA connectors.

In addition the easiest way of activating this Zigbee transmitter was to establish a link with an active Sensor device which required the antenna to be connected.

Testing was carried out on three channels being 2405.000 MHz, 2440.000 MHz and 2460.000 MHz as the module has the ability to operate on one of 15 channels with a 5 MHz separation from 2405 – 2480 MHz

Measurements were made using a spectrum analyser with a resolution bandwidth of 1 MHz when the transmitter was setup to operate on discrete frequencies.

Frequency (MHz)	Field Strength (dBuV/m)	Power (dBm)	Power (watts)	Limit (watts)
2405.000	113.5	18.3	0.068	1.0
2440.000	114.0	18.8	0.075	1.0
2460.000	114.0	18.8	0.077	1.0

The client advises that the coax connection to the module transmitter and the antenna gain approximate to a gain of 1 or 0 dB.

Therefore the conducted limit of 1 watt (+30 dBm) has been applied.

Radiated measurements were made using vertical and horizontal polarisations.

The power level in watts was determined by formula from the field strength using the formula
Field strength (V/m) = (square root of (30 x transmitter power (watts))) / distance (metres)

The transmitter itself was placed in the centre of the test table at a height of 80 cm above the ground plane.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

Result: Complies

Measurement Uncertainty: ± 4.1 dB

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Test Report No **091216.10**

Report date: 14 April 2010

Section 15.247 (d) – Out of band emissions

Band edge measurements:

At the band edges of 2400 MHz and 2483.5 MHz all emissions are required to be attenuated by more than 20 dB relative to the highest 100 kHz resolution bandwidth emission level observed in the band of operation.

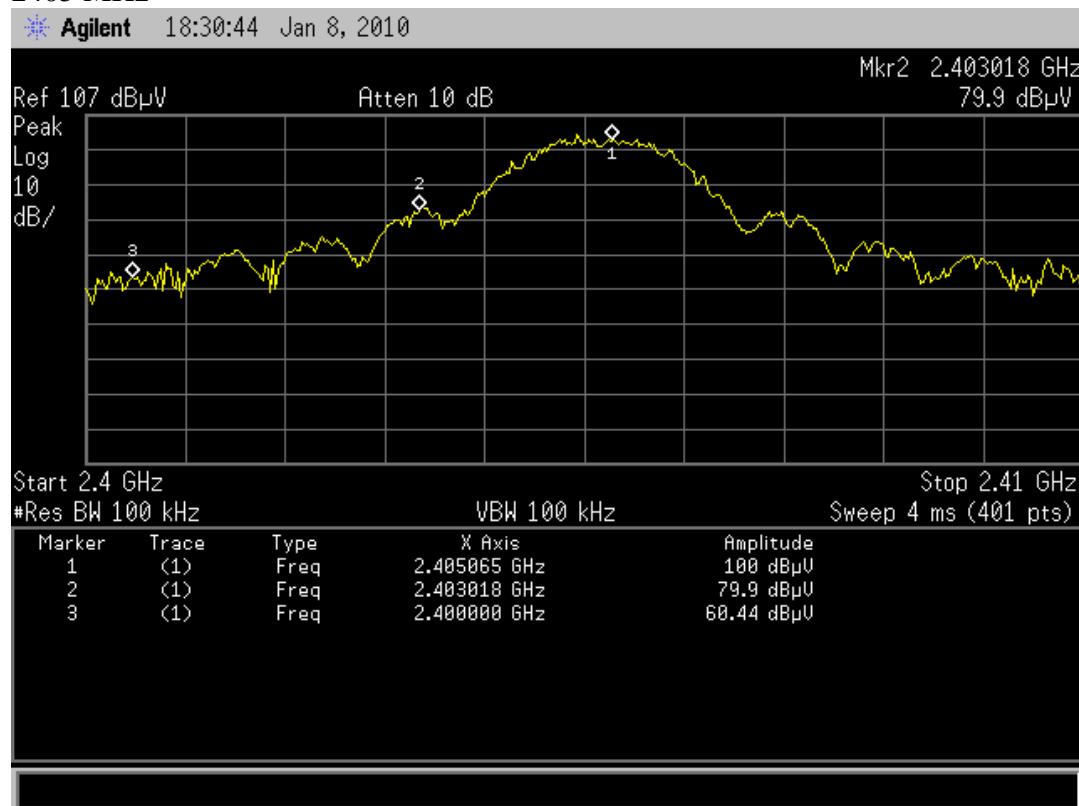
Testing was carried out when the device was transmitting on 2405 MHz and 2460 MHz with the -20 dB points determined as below.

20 dB bandwidth points

Frequency (MHz)	F low (MHz)	F high (MHz)
2405.000	2403.01725	-
2460.000	-	2461.9750

Spectrum plots showing these measurements is detailed below

2405 MHz



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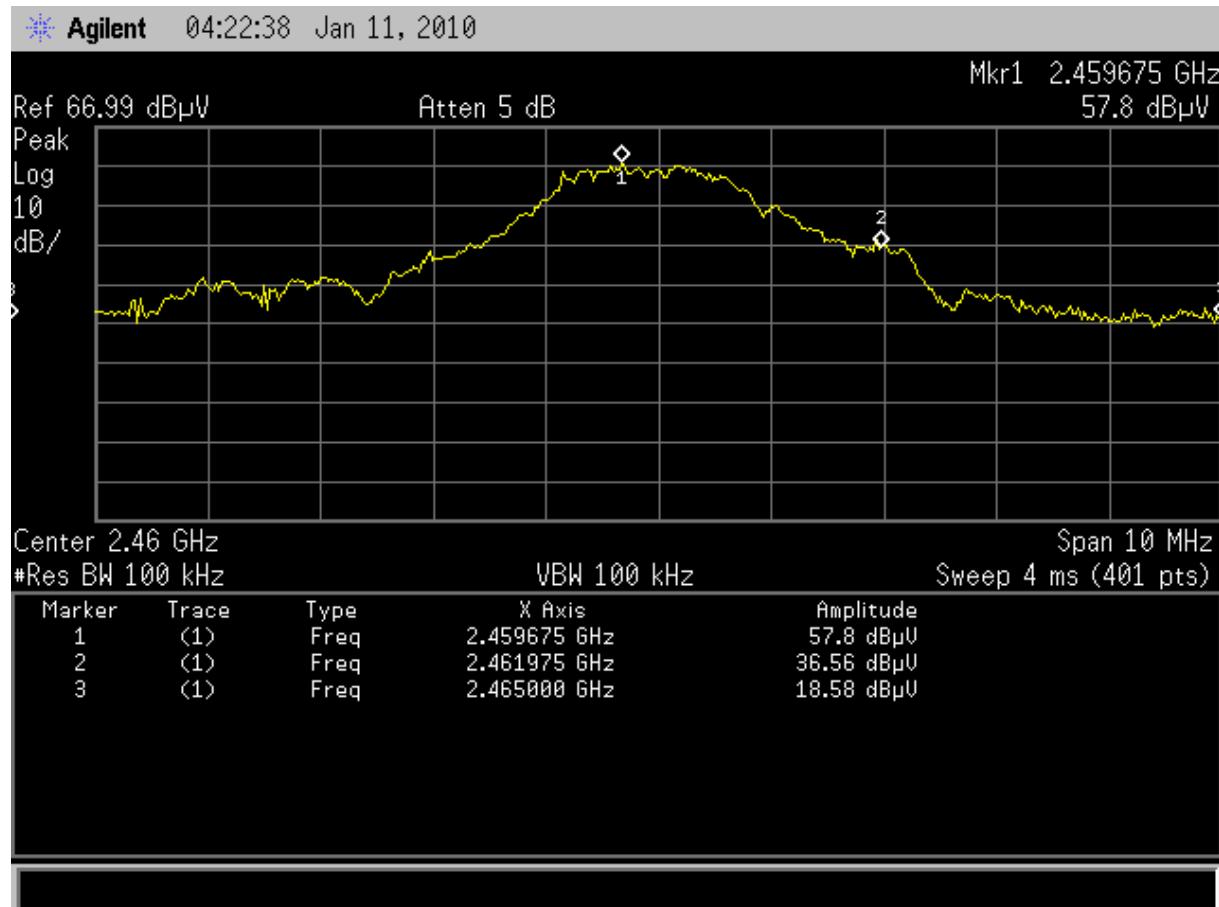
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Test Report No **091216.10**

Report date: 14 April 2010

2460 MHz



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Test Report No **091216.10**

Report date: 14 April 2010

Radiated emission measurements were made at the open area test site to confirm these levels.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
2405.000	113.5	108.0	-	-	Peak	Vertical
2400.000	86.0		93.5	7.5	Peak	Vertical
2400.000		79.0	88.0	9.0	Peak	Horizontal
2390.000	70.2	66.1	74.0	3.8	Peak	Vertical
2390.000	41.6	41.5	54.0	12.4	Average	Vertical
2460.000	114.0	107.0	-	-	Peak	Vertical
2483.500	73.5	66.1	74.0	0.5	Peak	Vertical
2483.500	42.6	42.5	54.0	11.4	Average	Vertical

When operating on 2405 MHz emissions at the band edge of 2400 MHz were attenuated by more than 20 dBc.

When operating on 2405 MHz the highest emissions observed in the 2310 MHz – 2390 MHz restricted band are recorded above and were observed to comply with the limits for this band.

When operating on 2460 MHz the highest emissions observed in the 2483.5 MHz – 2500 MHz restricted band are recorded above and were observed to comply with the limits for this band.

Result: Complies

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Spurious emissions and restricted band radiated emission measurements

Radiated peak power measurements were made as the antenna port could not be easily accessible due to the use of reverse SMA connectors.

In addition the easiest way of activating this Zigbee transmitter was to establish a link with an active Sensor device which required the antenna to be connected.

A number of out of band emissions have been shown to fall within the restricted bands of operation as defined in section 15.205(a).

Radiated emission measurements were carried out with the limits as per section 15.209 applied when these emissions fell within the restricted bands.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland.

The transmitter was placed on the test table top which was a total of 0.8 m above the test site ground plane.

Measurements of the radiated field were made 3 metres from the transmitting antenna.

Measurements below 1000 MHz were made using a Quasi Peak Detector with a bandwidth of 120 kHz.

Measurements above 1000 MHz were made using an average detector with a bandwidth of 1.0 MHz and also a peak detector with a bandwidth of 1.0 MHz.

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.

All emissions were 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)

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

2405.000 MHz harmonic emissions observed

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4810.000	63.6	51.8	74.0	10.4	Peak	Vertical
4810.000	38.7	38.5	54.0	15.3	Average	Vertical
7215.000	70.5	63.3	74.0	3.5	Peak	Vertical
7215.000	46.8	46.6	54.0	7.2	Average	Vertical
9620.000	62.9	53.6	74.0	11.1	Peak	Vertical
9620.000	39.5	40.3	54.0	13.7	Average	Horizontal
12025.000	66.2	58.2	74.0	7.8	Peak	Vertical
12025.000	44.1	44.1	54.0	9.9	Average	Vertical
14430.000	61.6	60.7	74.0	12.4	Peak	Vertical
14430.000	47.6	47.6	54.0	6.4	Average	Vertical
16835.000	57.8	57.6	74.0	16.2	Peak	Vertical
16835.000	44.8	44.7	54.0	9.2	Average	Vertical
19240.000	-	-	74.0	-	Peak	Vertical
19240.000	-	-	54.0	-	Average	Vertical
21645.000	-	-	74.0	-	Peak	Vertical
21645.000	-	-	54.0	-	Average	Vertical

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

2440.000 MHz harmonic emissions observed

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4880.000	65.5	51.8	74.0	8.5	Peak	Vertical
4880.000	38.7	38.7	54.0	15.3	Average	Vertical
7320.000	72.8	64.3	74.0	1.2	Peak	Vertical
7320.000	47.3	47.2	54.0	6.7	Average	Vertical
9760.000	62.9	53.1	74.0	11.1	Peak	Vertical
9760.000	39.7	39.6	54.0	14.3	Average	Vertical
12200.000	69.4	57.4	74.0	4.6	Peak	Vertical
12200.000	43.5	43.5	54.0	10.5	Average	Vertical
14640.000	61.3	60.2	74.0	12.7	Peak	Vertical
14640.000	46.5	46.5	54.0	7.5	Average	Vertical
17080.000	60.3	60.2	74.0	13.7	Peak	Vertical
17080.000	47.1	47.0	54.0	6.9	Average	Vertical
19520.000	-	-	74.0	-	Peak	Vertical
19520.000	-	-	54.0	-	Average	Vertical
21960.000	-	-	74.0	-	Peak	Vertical
21960.000	-	-	54.0	-	Average	Vertical

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

2460.000 MHz harmonic emissions observed

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4920.000	64.0	52.1	74.0	10.0	Peak	Vertical
4920.000	39.0	39.1	54.0	14.9	Average	Horizontal
7380.000	73.0	67.3	74.0	1.0	Peak	Vertical
7380.000	49.0	37.6	54.0	5.0	Average	Vertical
9840.000	63.7	63.1	74.0	10.3	Peak	Vertical
9840.000	40.3	40.4	54.0	13.6	Average	Horizontal
12300.000	67.3	57.5	74.0	6.7	Peak	Vertical
12300.000	43.7	43.5	54.0	10.3	Average	Vertical
14760.000	62.1	58.8	74.0	11.9	Peak	Vertical
14760.000	45.3	45.3	54.0	8.7	Average	Vertical
17220.000	-	-	74.0	-	Peak	Vertical
17220.000	-	-	54.0	-	Average	Vertical
19680.000	-	-	74.0	-	Peak	Vertical
19680.000	-	-	54.0	-	Average	Vertical
22140.000	-	-	74.0	-	Peak	Vertical
22140.000	-	-	54.0	-	Average	Vertical

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Other emissions observed

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
9654.400	74.0		94.0	20.0	Peak	Vertical
9654.400		68.7	88.0	19.3	Peak	Horizontal

The above emission falls outside of the restricted bands therefore the -20 dBc limits have been applied.

The frequency of the emission does not vary with a change in the operating frequency.

The highest level observed in the operating band was 114 dBuV/m in vertical and 108 dBuV/m in horizontal.

No other spurious emissions detected from the transmitter when observations were made up to 24 GHz at a distance of 3 metres.

A dash in the result column indicates that a measurement was attempted on a frequency but no emissions were observed.

Result: Complies

Measurement uncertainty: ± 4.1 dB

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Section 15.247 (e) – Power Spectral Density

For digitally modulated systems the power spectral density conducted from the intentional radiator to the antenna shall not exceed 8 dBm in any 3 kHz band.

Measurements have been made using radiated test methods with the conducted power being derived.

It has been assumed that the integral antenna has unity gain (0 dB).

Measurements were made using 12 and 24 Vdc however this variation in DC supply voltage did not vary the observed output power.

The radiated power was derived from the field strength using the formula:

Power (watts) = (Field Strength (V/m) * Distance (m))^2 / 30 * Antenna Gain.

Frequency (MHz)	Level (dBuV/m)	Density (dBm)	Limit (dBm)	Antenna Polarisation
2405.5300	97.2	2.0	8.0	Vertical
2440.0260	97.8	2.6	8.0	Vertical
2460.2224	98.0	2.8	8.0	Vertical

Measurements were made at the test site over a distance of 3 metres in both vertical and horizontal polarisations.

Result: Complies

Measurement Uncertainty: ± 4.1 dB

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Section 15.247(i) – Radio Frequency Hazard Information

As per Section 15.247 (b) (4) spread spectrum transmitters operating in the 2400 – 2483.5 MHz band are required to be operated in a manner that ensures that the public is not exposed to RF energy levels in accordance with CFR 47, Section 1.1307(b)(1).

The device when in operation is fixed and a safe distance could be maintained when events are undertaken.

The device contains 2 transmitters that operate at similar power levels.

In accordance with Section 1.1310 the Maximum Permissible Exposure (MPE) limits for the General Population / Uncontrolled Exposure of 1 mW/cm² has been applied.

The maximum distance from the antenna at which the MPE is met or exceeded is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain and separation distance in metres:

$$E, \text{V/m} = (\sqrt{30 * P * G}) / d$$

$$\text{Power density, mW/cm}^2 = E^2/3770$$

$$E \text{ for MPE: } 1 = E^2/3770$$

$$E = \sqrt{1 * 3770}$$

$$E = 61.4 \text{ V/m}$$

The highest radiated power has been measured to be +18.8 dBm or 0.078 watts EiRP when operating on 2440.000 MHz

Therefore:

$$E = \sqrt{30 * P * G} / d$$

$$d = \sqrt{30 * P * G} / E$$

$$d = \sqrt{30 * 0.08} / 61.4$$

$$d = 0.025 \text{ m or } 2.5 \text{ cm}$$

Result: Complies if a minimum safe distance of 20 cm is specified in the set up instructions for this system.

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Section 15.247: WLAN transmitter verification

Measurements were made to confirm that the WLAN module was operating in the 2400 – 2483.5 MHz at a power level that was in compliance with this band.

The device was observed to be a direct sequence spread spectrum digital transmitter that could be configured using software for test purposes to operate on US channels 1 to 11

Testing was carried out on the channel that the client had pre-set the device to operate on channel 11, approximately 2462 MHz, in order that it would not interfere with the sensor transmitter that was operating on 2445 MHz.

As the emission was wide band power measurements were made in steps of 5 MHz using a spectrum analyser with a resolution bandwidth of 5 MHz with the resulting powers summed and applied against the conducted limit of 1 watt (+30 dBm).

It has been assumed that the antenna and connecting coax give an overall gain of 0 dBi.

Vertical polarisation was determined to be the worst level with the device also being rotated and height scanned.

Frequency MHz	Level dBuV/m	Power dBm	Power Watts	Summed Watts	Power dBm	Limit dBm
2452.000	94.3	-0.9	0.00080746			
2457.000	106.6	11.4	0.01371265			
2462.000	110.3	15.1	0.03214558			
2467.000	107.9	12.7	0.01849785	0.1	18.2	30.0
2472.000	96.7	1.5	0.00140644			

It can also be seen that the 6 dB bandwidth will be greater than 500 kHz.

A 3 dB bandwidth was observed between 2457 – 2467 MHz which is 10 MHz.

No spurious emissions were observed from the WLAN transmitter when observations were made between 2 – 24 GHz when using vertical and horizontal polarisations at a distance of 3 metres.

No inter-modulation products were observed when the WLAN and the Sensor Transmitters contained within this device were operating.

Result: Complies.

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Test Report No **091216.10**

Report date: 14 April 2010

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3613
Receiver	R & S	ESCS 30	847124/020	E1595
Receiver	R & S	ESHS 10	828404/005	RFS 3728
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785
Horn Antenna	EMCO	3115	9511-4629	E1526
Horn Antenna	EMCO	3116	92035	-
Microwave Pre Amp	Hewlett Packard	8349B	2644A01659	-
Mains Network	R & S	ESH2-Z5	881362/034	3628
Variac	General Radio	1592	-	RFS 3690
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3613

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies Ltd registration with the Federal Communications Commission as a listed facility, registration number: 90838, which was updated on January 23rd, 2010.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025, 2005.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025, 2005

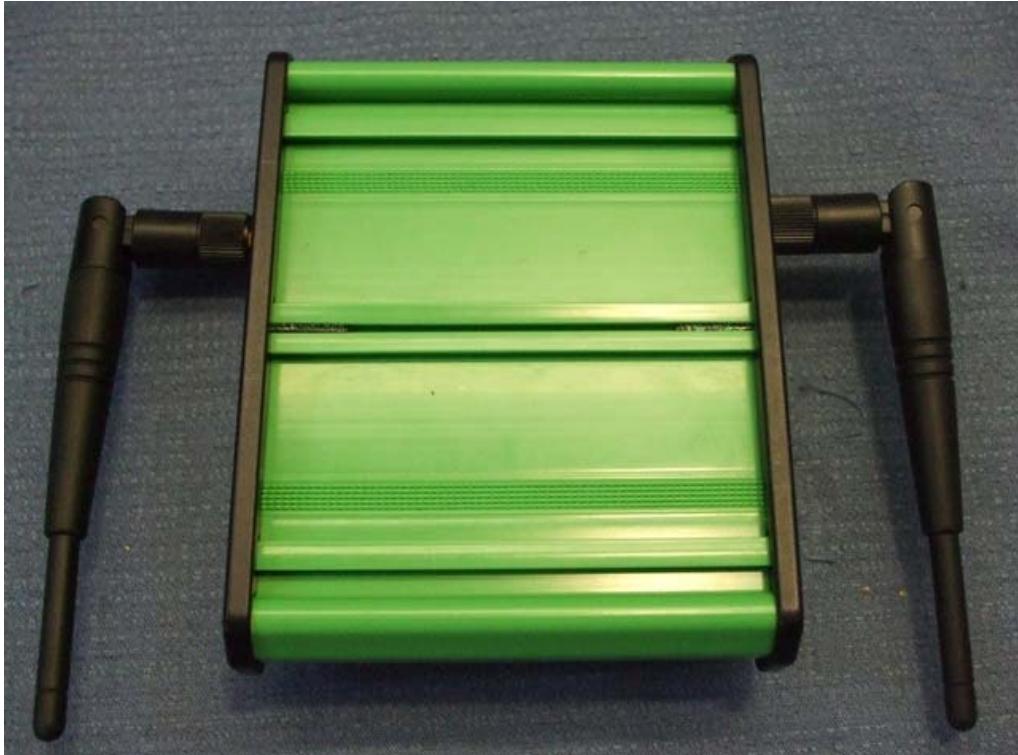
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied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

EMC Technologies (NZ) Ltd

Test Report No **091216.10**

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9. PHOTOGRAPHS External View



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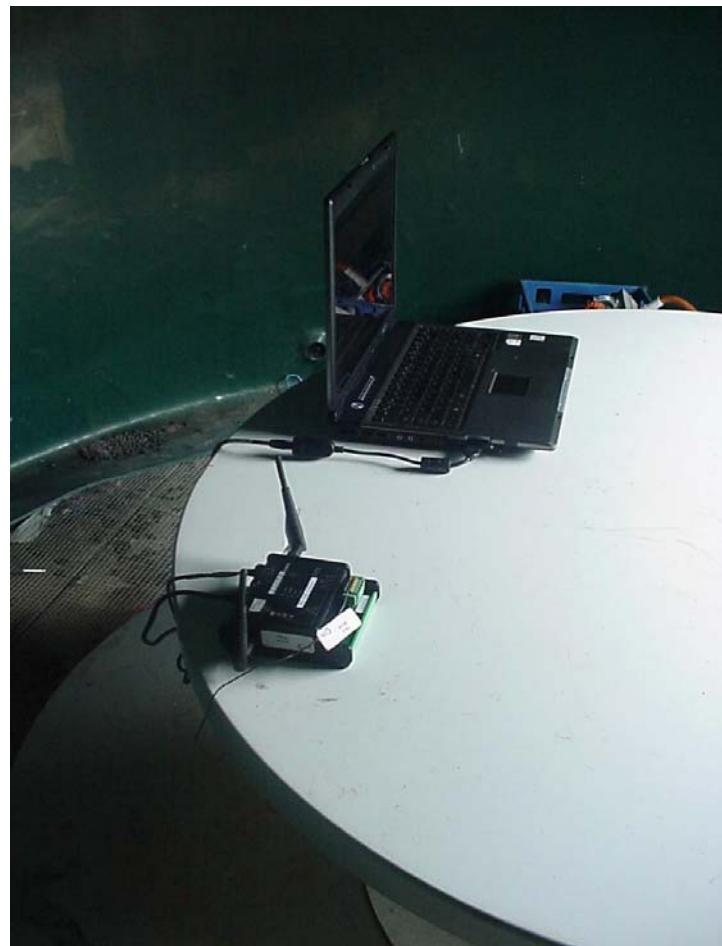
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EMC Technologies (NZ) Ltd

Test Report No **091216.10**

Report date: 14 April 2010

Radiated Emissions Test Set Up



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Conducted Emission Test Set Up



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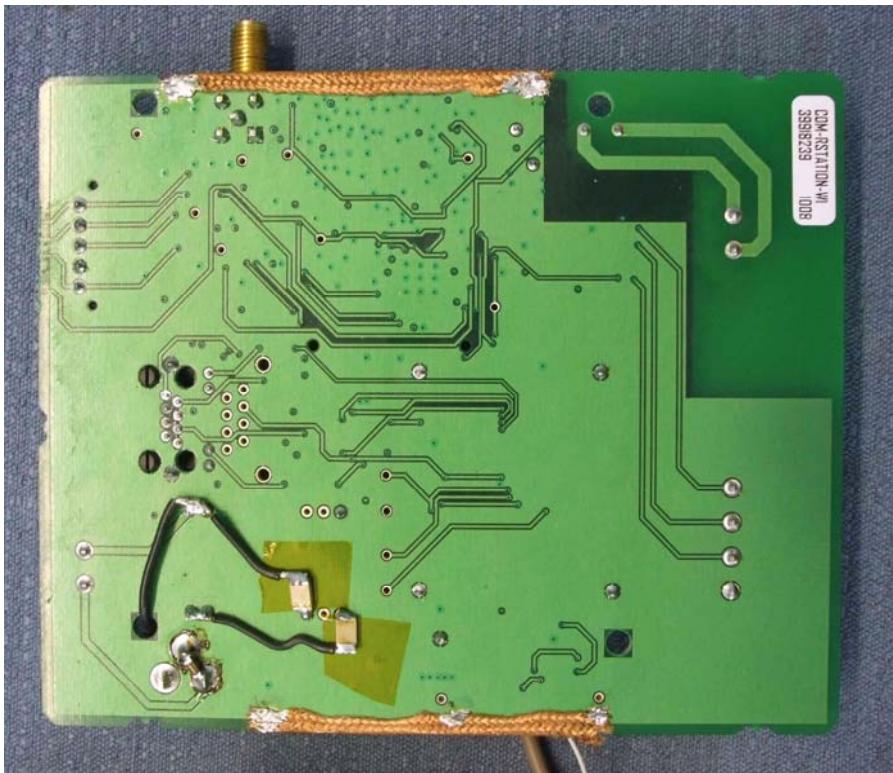
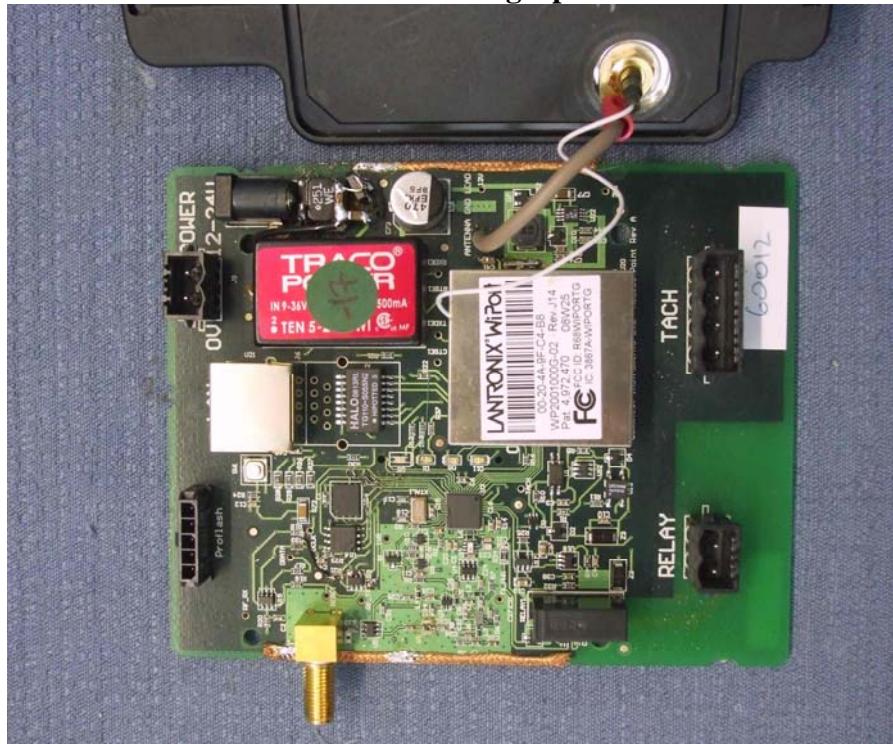
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EMC Technologies (NZ) Ltd

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Internal Photographs



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