

EMC Technologies (NZ) Ltd

Test Report No **091216.30**

Report date: 14 April 2010

TEST REPORT

Commtest Ranger Sensor Transmitter

tested to

47 Code of Federal Regulations

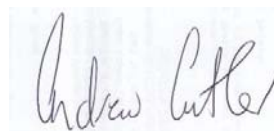
Part 15 - Radio Frequency Devices

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

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1. STATEMENT OF COMPLIANCE

The **Commtest Instruments Ranger Sensor Transmitter** 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	Not applicable. Internal battery powered
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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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	Sensor
Manufacturer	Commtest Instruments Ltd
Country of Origin	New Zealand
Serial Number	50235
FCC ID	V92RGSS

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Device description

This sensor forms part of a wireless sensor system.

It creates a link between the wireless sensor and a monitoring system, typically a computer, using a 2.4 GHz Zigbee link.

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

The device is powered using an internal battery that cannot be re-charged.

The RF communications are driven by the CC2430 microprocessor.

Under normal operation 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, 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.

The device is capable of operating between 2400 – 2460 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.

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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.

Section 15.203: Antenna requirement

This device has uses an internal antenna that is permanently attached.

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.

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Section 15.205: Restricted bands of operation

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

Result: Complies.

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.

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

Measurements have been attempted 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 with a 1 MHz bandwidth.

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.

Measures were attempted in both vertical and horizontal antenna polarisations.

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

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

No specific general emissions were detected from the device.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

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

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Section 15.247(a)(2): Minimum bandwidth

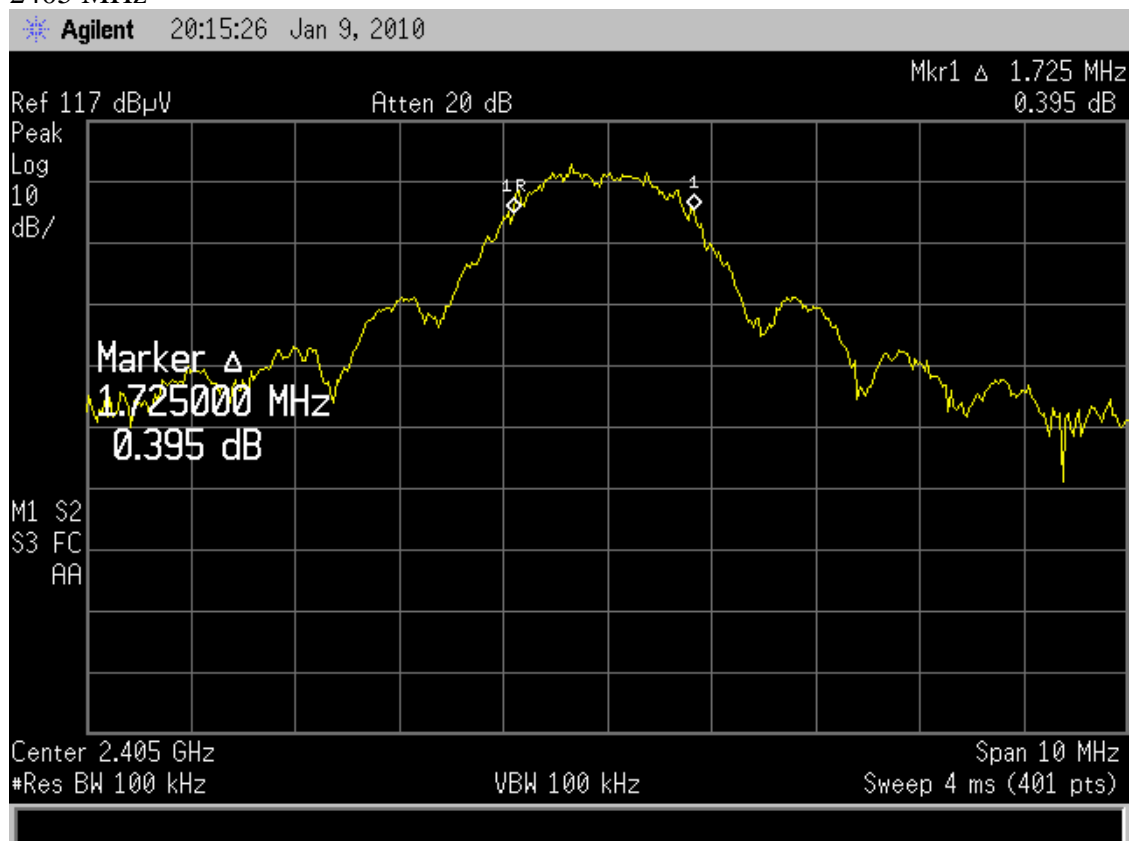
Systems using digital modulation techniques shall have a minimum 6 dB bandwidth of 500 kHz

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	1.6000
2480.000	1.6000

Result: Complies

2405 MHz



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E-mail: aucklab@ihug.co.nz

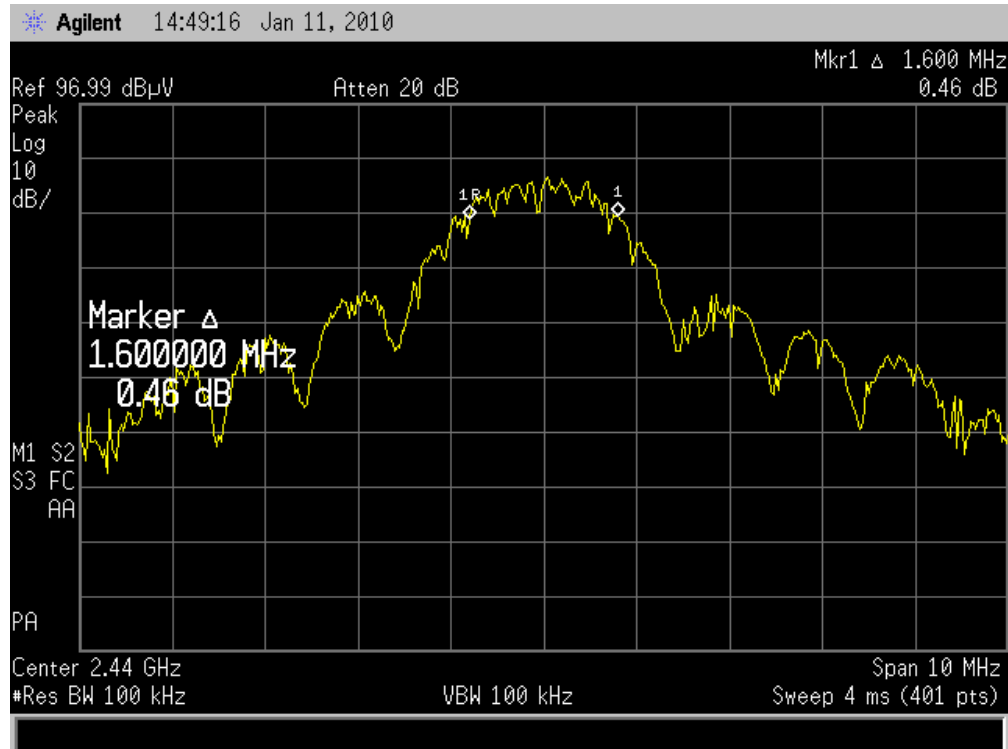
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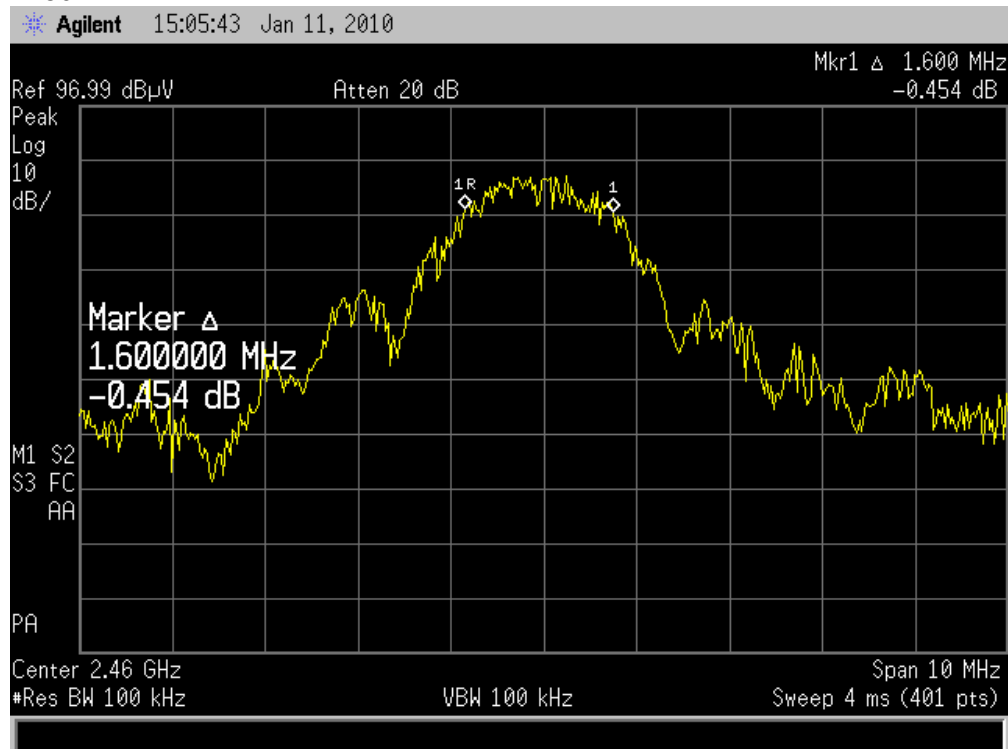
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2440 MHz



2480 MHz



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

Radiated peak power measurements were made as the antenna port could not be accessed.

Testing was carried out on three channels being 2405.000 MHz, 2440.000 MHz and 2460.000 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	91.7	-3.5	0.00044	1.0
2440.000	91.0	-4.2	0.00038	1.0
2460.000	90.1	-5.1	0.00031	1.0

The client advises that the antenna gain is approximately 1 or 0 dBi.

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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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.

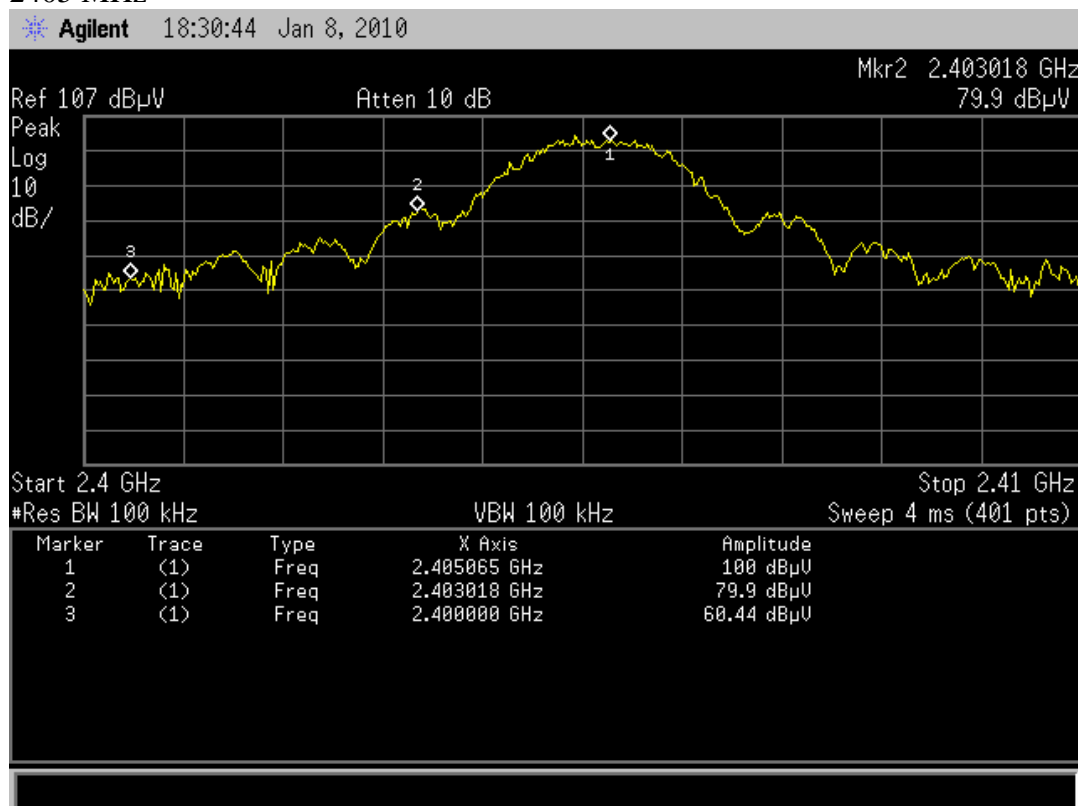
Testing was carried out when the device was transmitting on 2405 MHz and 2460 MHz with the -20 dB points determined as below.

20 dB bandwidth points

Frequency (MHz)	F low (MHz)	F high (MHz)
2405.000	2403.01800	-
2480.000	-	2461.2500

Spectrum plots showing these measurements is detailed below

2405 MHz



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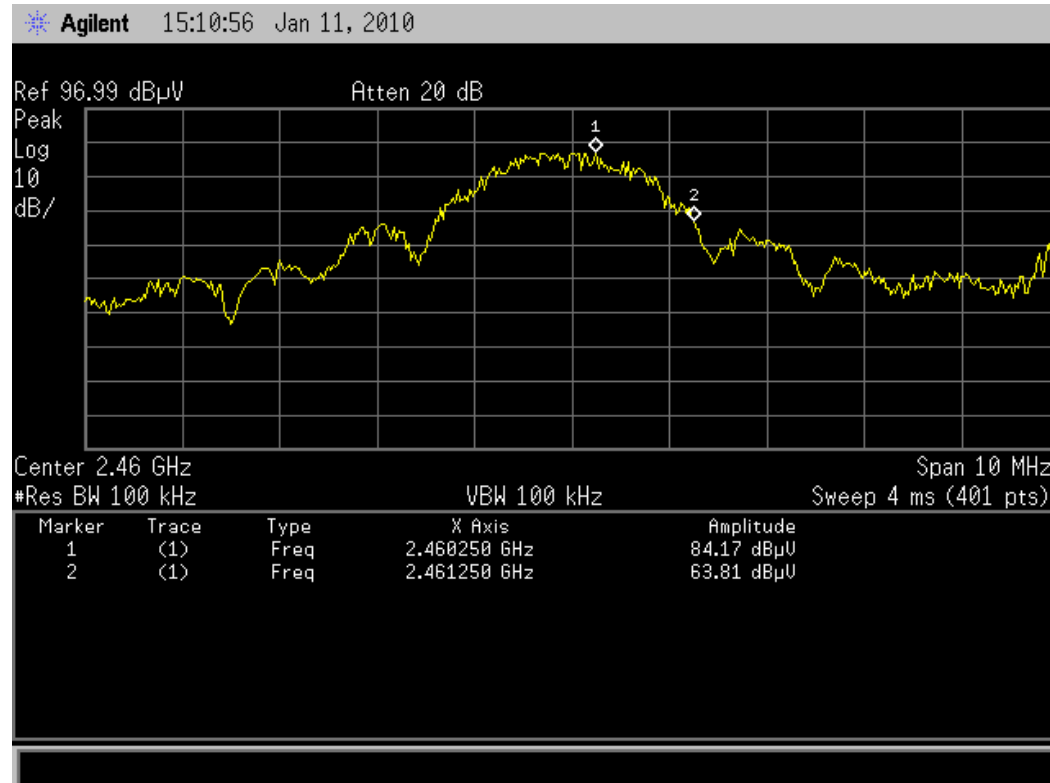
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2460 MHz



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POSTAL ADDRESS - PO Box 68 307, Newton, Auckland, New Zealand

Telephone: +64 9 360 0862 Fax: +64 9 360 0861

E-mail: aucklab@ihug.co.nz

Web Site: www.emctech.com.au

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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	89.0	91.7			Peak	Vertical
2400.000	54.5		69.0	14.5	Peak	Vertical
2400.000		54.3	71.7	17.4	Peak	Horizontal
2390.000	54.0	53.9	74.0	20.0	Peak	Vertical
2390.000	42.0	41.9	54.0	12.0	Average	Vertical
2460.000	88.4	90.1			Peak	Vertical
2483.500	55.3	53.7	74.0	18.7	Peak	Vertical
2483.500	42.3	42.1	54.0	11.7	Average	Vertical

Result: Complies

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Spurious emissions and restricted band radiated emission measurements

Radiated peak power measurements were made as the antenna port could not be accessed.

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)

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Transmitting on 2405.000 MHz

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4810.000	-	-	74.0	-	Peak	Vert/Hort
4810.000	-	-	54.0	-	Average	Vert/Hort
7215.000	-	-	74.0	-	Peak	Vert/Hort
7215.000	-	-	54.0	-	Average	Vert/Hort
9620.000	-	-	74.0	-	Peak	Vert/Hort
9620.000	-	-	54.0	-	Average	Vert/Hort
12025.000	-	-	74.0	-	Peak	Vert/Hort
12025.000	-	-	54.0	-	Average	Vert/Hort
14430.000	-	-	74.0	-	Peak	Vert/Hort
14430.000	-	-	54.0	-	Average	Vert/Hort
16835.000	-	-	74.0	-	Peak	Vert/Hort
16835.000	-	-	54.0	-	Average	Vert/Hort
19240.000	-	-	74.0	-	Peak	Vert/Hort
19240.000	-	-	54.0	-	Average	Vert/Hort
21645.000	-	-	74.0	-	Peak	Vert/Hort
21645.000	-	-	54.0	-	Average	Vert/Hort

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Transmitting on 2440.000 MHz

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4880.000	-	-	74.0	-	Peak	Vert/Hort
4880.000	-	-	54.0	-	Average	Vert/Hort
7320.000	-	-	74.0	-	Peak	Vert/Hort
7320.000	-	-	54.0	-	Average	Vert/Hort
9760.000	-	-	74.0	-	Peak	Vert/Hort
9760.000	-	-	54.0	-	Average	Vert/Hort
12200.000	-	-	74.0	-	Peak	Vert/Hort
12200.000	-	-	54.0	-	Average	Vert/Hort
14640.000	-	-	74.0	-	Peak	Vert/Hort
14640.000	-	-	54.0	-	Average	Vert/Hort
17080.000	-	-	74.0	-	Peak	Vert/Hort
17080.000	-	-	54.0	-	Average	Vert/Hort
19520.000	-	-	74.0	-	Peak	Vert/Hort
19520.000	-	-	54.0	-	Average	Vert/Hort
21960.000	-	-	74.0	-	Peak	Vert/Hort
21960.000	-	-	54.0	-	Average	Vert/Hort

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Transmitting on 2460.000 MHz

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4920.000	-	-	74.0	-	Peak	Vert/Hort
4920.000	-	-	54.0	-	Average	Vert/Hort
7380.000	-	-	74.0	-	Peak	Vert/Hort
7380.000	-	-	54.0	-	Average	Vert/Hort
9840.000	-	-	74.0	-	Peak	Vert/Hort
9840.000	-	-	54.0	-	Average	Vert/Hort
12300.000	-	-	74.0	-	Peak	Vert/Hort
12300.000	-	-	54.0	-	Average	Vert/Hort
14760.000	-	-	74.0	-	Peak	Vert/Hort
14760.000	-	-	54.0	-	Average	Vert/Hort
17220.000	-	-	74.0	-	Peak	Vert/Hort
17220.000	-	-	54.0	-	Average	Vert/Hort
19680.000	-	-	74.0	-	Peak	Vert/Hort
19680.000	-	-	54.0	-	Average	Vert/Hort
22140.000	-	-	74.0	-	Peak	Vert/Hort
22140.000	-	-	54.0	-	Average	Vert/Hort

No harmonics emissions were observed from this transmitter with a minimum margin of 15 dB being observed between the noise floor of the measuring instrument and the limit across the frequency range observed

Result: Complies

Measurement uncertainty: ± 4.1 dB

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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:

$$\begin{aligned} E, \text{ V/m} &= (\sqrt{30 * P * G}) / d \\ \text{Power density, mW/cm}^2 &= E^2 / 3770 \\ E \text{ for MPE: } 1 &= E^2 / 3770 \\ E &= \sqrt{1 * 3770} \\ E &= 61.4 \text{ V/m} \end{aligned}$$

The highest radiated power has been measured to be -3.5 dBm or 0.00044 watts EIRP when operating on 2405.000 MHz

Therefore:

$$\begin{aligned} E &= \sqrt{30 * P * G} / d \\ d &= \sqrt{30 * P * G} / E \\ d &= \sqrt{30 * 0.00044} / 61.4 \\ d &= 0.002 \text{ m or } 0.2 \text{ cm} \end{aligned}$$

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

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7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applic
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applic
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applic
Receiver	R & S	ESHS 10	828404/005	3728	21 Aug 2010
Mains Network	R & S	ESH2-Z5	881362/032	3628	21 Aug 2010
Receiver	R & S	ESCS 30	847124/020	E1595	21 Feb 2011
Receiver	R & S	ESIB 40	100171	R-27-1	21 Aug 2010
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	20 April 2010
Microwave Preamplifier	Hewlett Packard	8349B	2644A01659	-	20 April 2010
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2011
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2011
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2011
Horn Antenna	Electrometrics	RGA-60	6234	E1492	10 May 2010
Horn Antenna	EMCO	3116	2276	-	10 May 2010

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.

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9. PHOTOGRAPHS



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Telephone: +64 9 360 0862 Fax: +64 9 360 0861

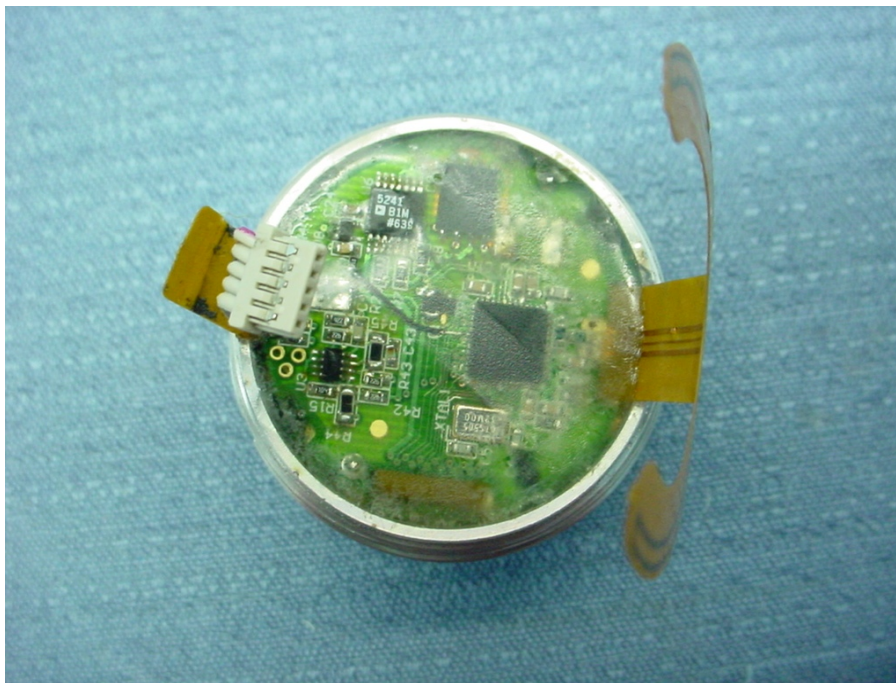
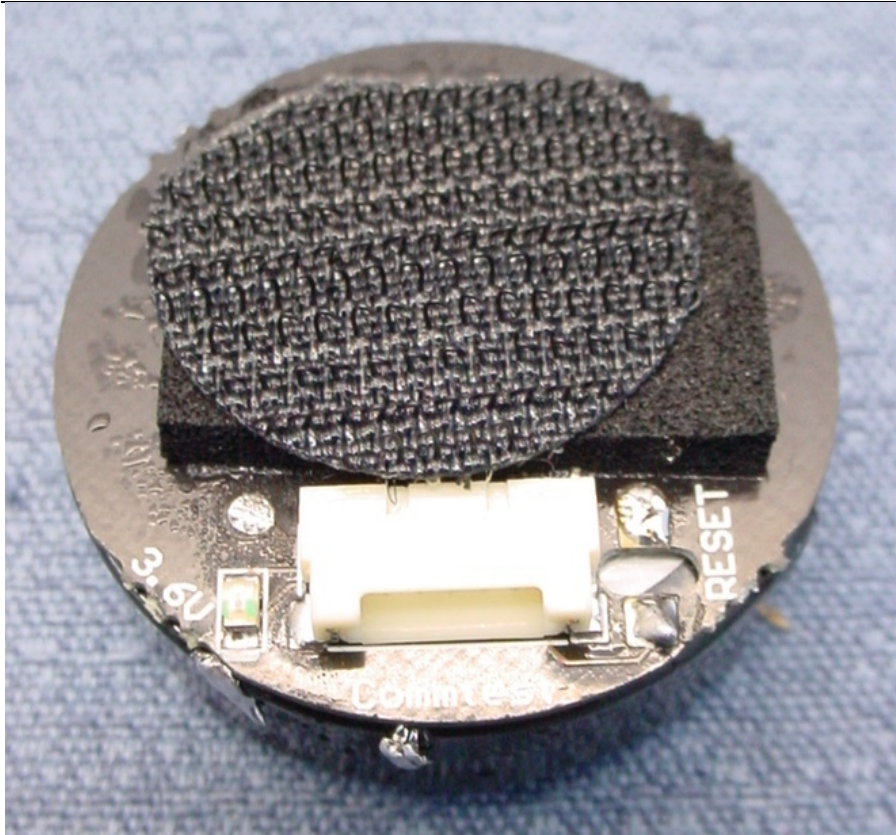
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