EMC Technologies (NZ) Ltd
PO Box 68-307
Newton, Auckland
New Zealand
Phone 09 360 0862
Fax 09 360 0861
E-Mail Address: aucklab@ihug.co.nz
Web Site: www.emctech.com.au

TEST REPORT

Commtest Ranger Station Ranger System

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

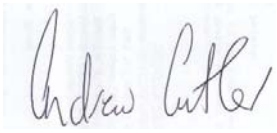
Subpart C – Intentional Radiators

including

Section 15.247 - Operation in the band 2400 – 2483.5 MHz

for

GE Energy NZ Ltd



This Test Report is issued with the authority of:

Andrew Cutler - General Manager

IANZ ACCREDITED LABORATORY

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

Table of Contents

1. STATEMENT OF COMPLIANCE

The **Commtest Ranger Station Ranger System** complies with FCC Part 15 Subpart C including Section 15.247 as an Intentional Radiator when the methods as described in ANSI C63.4 - 2003 and those defined in FCC KDB 558074 D01 v03r02.

2. RESULTS SUMMARY

The results of testing carried out during October 2014 are detailed below:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required.
15.203	Antenna requirement	Complies.
15.204	External PA and antenna modifications	Noted.
15.205	Restricted bands of operation	Complies.
15.207	Conducted limits	Complies
15.209	Radiated emission limits	Complies.
15.247		
(a)(2)	Minimum bandwidth	Complies
(b)(3)	Peak output power	Complies
(b)(4)	Antenna gain less than 6 dBi	Complies
(c)	Operation with directional antenna	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

3. INTRODUCTION

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 contains no corrections.

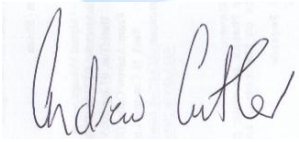
Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

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

4. CLIENT INFORMATION

Company Name	GE Energy NZ Ltd
Address	Level 2 22 Moorhouse Avenue
City	Christchurch
Country	New Zealand
Contact	Mr Brian Wood

5. DESCRIPTION OF TEST SYSTEM

Brand Name	Commtest
Model Number	Ranger Station
Product	Ranger System
Manufacturer	GE Energy NZ Ltd
Country of Origin	New Zealand
Serial Number	73000
FCC ID	V92RGST2

Device description

Some time ago FCC testing and certification was achieved for this device with the FCC ID: V92RGST.

Recently modifications were to this device which as required the device to be completely retested and re-certified as a new device

The following modifications have been made:

- Balun removed
- 2 analogue switches removed
- MAX2242 transmission amplifier removed
- MAX2644 low noise receiver amplifier removed
- A single RF6555 transmitter / receiver chip has been installed

The microprocessor, power supplies, filtering, WiFi / Ethernet module and firmware have remained the same.

As previously described 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 link between the sensor and the base station.

Either a wired Ethernet connection or a 2.4 GHz wireless LAN connection is then used 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.

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 IC ID: 3867A-WIPORTG

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

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

Re-testing has been carried out at 2405 MHz, 2440 MHz and 2460 MHz to show continued compliance.

6. RESULTS

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C.

Methods and Procedures

The following measurement methods and procedures have been applied:

- ANSI C63.4 – 2003

- FCC Public Notice DA 00-0705

Section 15.201: Equipment authorisation requirement

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

Certification is sought for the Zigbee transmitter

The device also contains a WLAN transmitter which has been certified as a FCC compliant module with FCC ID: R68WIPORTG

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.

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 15.107: Conducted limits

Conducted emission testing has been carried out when the device was powered at 120 Vac 60 Hz using a representative AC power supply.

Conducted emission testing was carried out over the frequency range of 150 kHz to 30 MHz 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 in accordance with section 15.207(a) using a measuring receiver and a 50 uH / 50 ohm artificial mains network which is also known as a line impedance stabilisation network (LISN).

Measurements on both the phase and neutral lines were made using either a Quasi Peak or an Average detector with a 9 kHz bandwidth.

The supplied conducted emission plot is a combined plot showing the worst case of the Peak, Quasi Peak and Average levels for both phase and neutral.

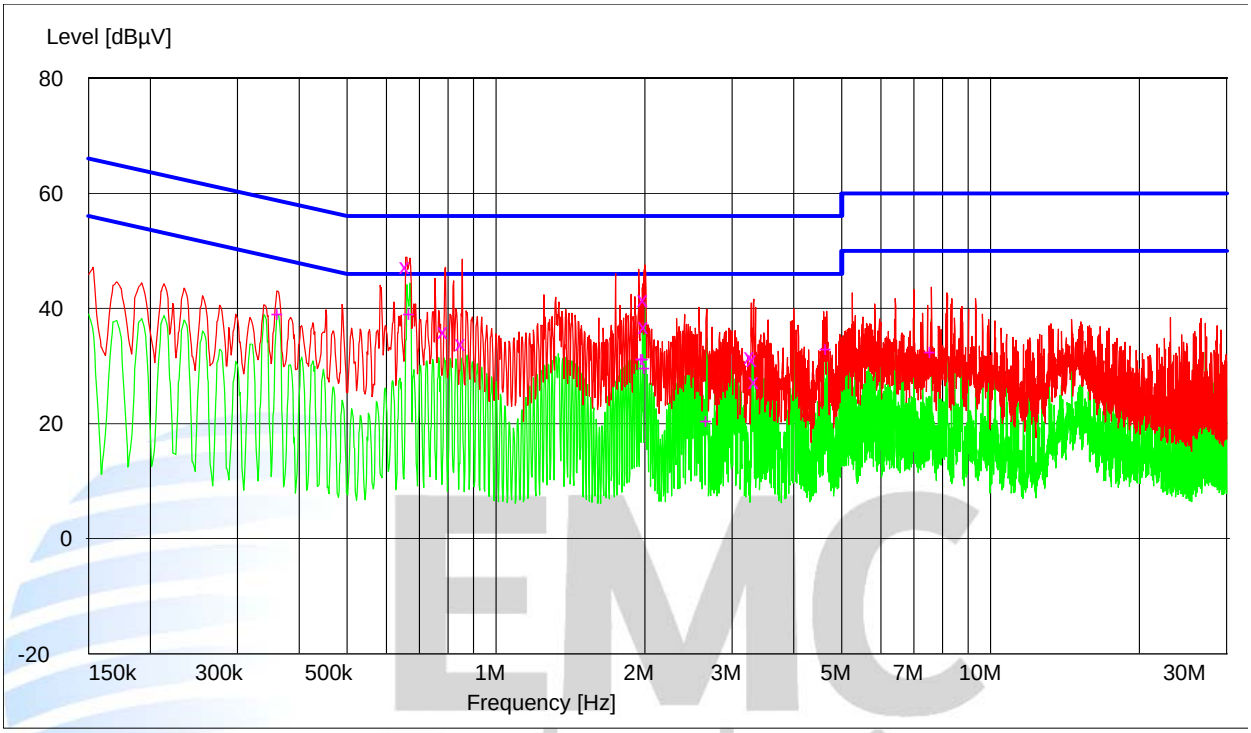
The Class B conducted limits have been applied.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
Conducted emissions tests (0.15 - 30 MHz) ± 2.2 dB

Conducted Emissions – AC Mains Port

Setup:	Device tested when transmitting and receiving continuously with a remote sensor when powered at 120 Vac 60 Hz while using a representative AC adaptor.

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



Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
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	

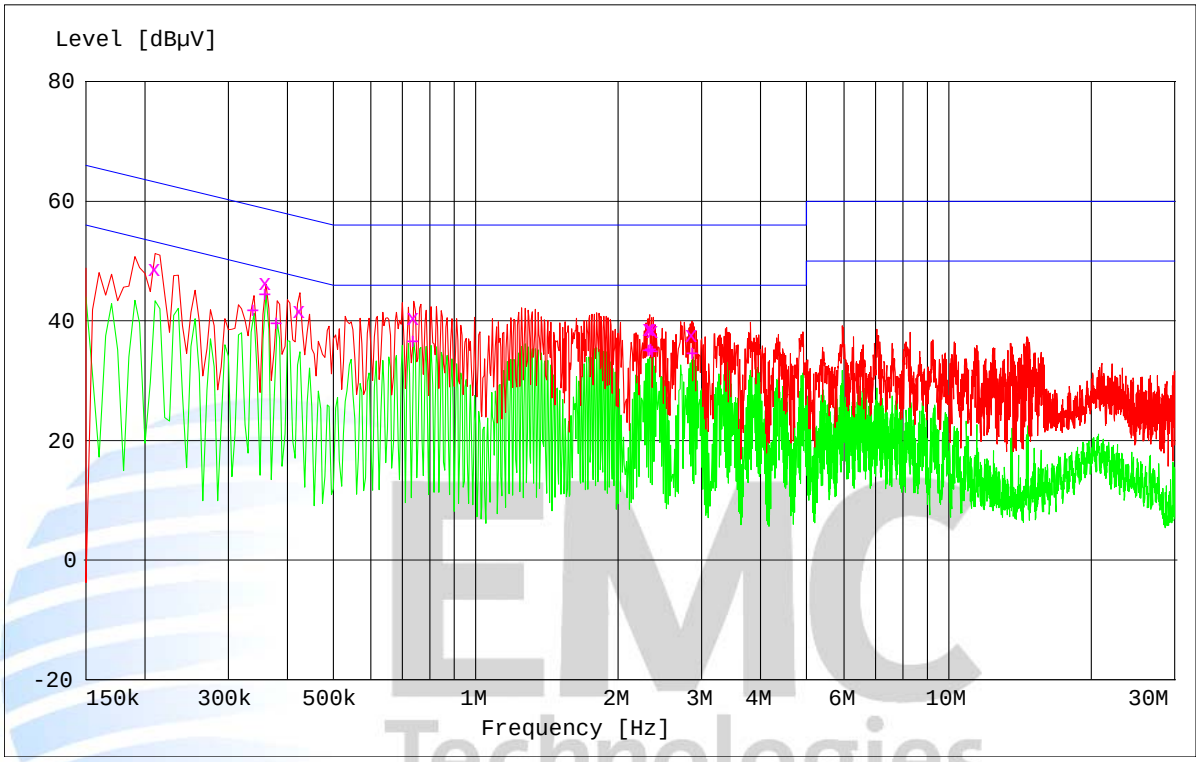
Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
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	

Conducted emissions – AC Mains Port

Comments:	Device tested when powered at 120 Vac 60 Hz when operating in WLAN mode

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



Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
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 dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
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	

Section 15.209 – Radiated emissions below 30 MHz

As this device contains digital devices that operate using frequencies below 30 MHz, low frequency measurements were attempted between 9 kHz – 30 MHz at the open area test site over a distance of 10 metres using a loop antenna the centre of which was 1 metre above the ground.

Details of the general test set up are provided in the photograph section of this report.

The general limits described in 15.209 have been applied with the 300 metre and 30 metre limits being extrapolated by a factor of 40 dB per decade as allowed for in section 15.31(d)(2).

Between 9 – 90 kHz and between 110 – 490 kHz an Average detector and a Peak detector were used.

Where a peak detector was used the limit was increased by +20 dB.

Between 90 kHz and 110 kHz band between 490 kHz and 30 MHz a Quasi Peak detector was used.

No emissions were detected on these frequencies of interest and no other emissions were detected from this device over the range of 9 kHz – 30 MHz

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (9 kHz – 30 MHz) ± 4.8 dB

Section 15.209 – Radiated emissions above 30 MHz

Ethernet and WLAN mode

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

The device was powered at 12 Vdc using an external 120 Vac power supply.

Attached to the device was a remotely located 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 10 metres away 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.

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/m) + Coax Loss (dB)

Results:

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna
34.649	35.6	23.6	40.0	4.4	Quasi Peak	Vertical
49.875	34.3		40.0	5.7	Quasi Peak	Vertical
58.719	31.3		40.0	8.7	Quasi Peak	Vertical
64.793	32.1		40.0	7.9	Quasi Peak	Vertical
81.198	27.3	27.9	40.0	12.1	Quasi Peak	Horizontal
108.823	28.1		43.5	15.4	Quasi Peak	Vertical
125.000		27.8	43.5	15.7	Quasi Peak	Horizontal
148.127	27.5		43.5	16.0	Quasi Peak	Vertical
164.000	32.1	29.8	43.5	11.4	Quasi Peak	Vertical
250.000	32.6	30.0	46.0	13.4	Quasi Peak	Vertical
320.000	24.8	30.7	46.0	15.3	Quasi Peak	Vertical
345.376		24.5	46.0	21.5	Quasi Peak	Horizontal
352.000	27.3	34.4	46.0	11.6	Quasi Peak	Vertical
375.000	28.7	31.5	46.0	14.5	Quasi Peak	Vertical
500.000		29.1	46.0	16.9	Quasi Peak	Horizontal
544.000		33.7	46.0	12.3	Quasi Peak	Horizontal
625.000	32.8	36.7	46.0	9.3	Quasi Peak	Vertical
750.000		33.2	46.0	12.8	Quasi Peak	Horizontal
875.000		34.6	46.0	11.4	Quasi Peak	Horizontal
1000.000		31.4	54.0	22.6	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.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 MHz – 24000 MHz) ± 4.1 dB

Section 15.247(a)(2) - Minimum bandwidth

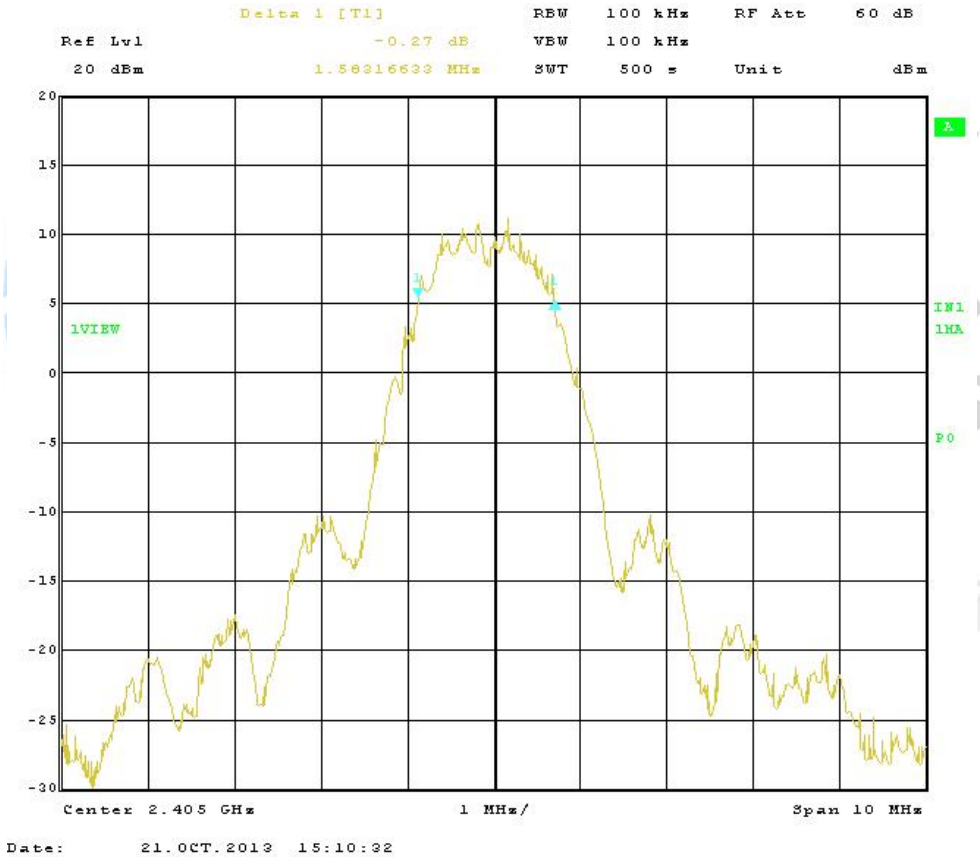
Digital devices operating in the 2400 - 2483.5 MHz band are required to have a minimum 6 dB bandwidth of 500 kHz.

Testing was carried on 2405 MHz, 2440 MHz and 2460 MHz with the following results:

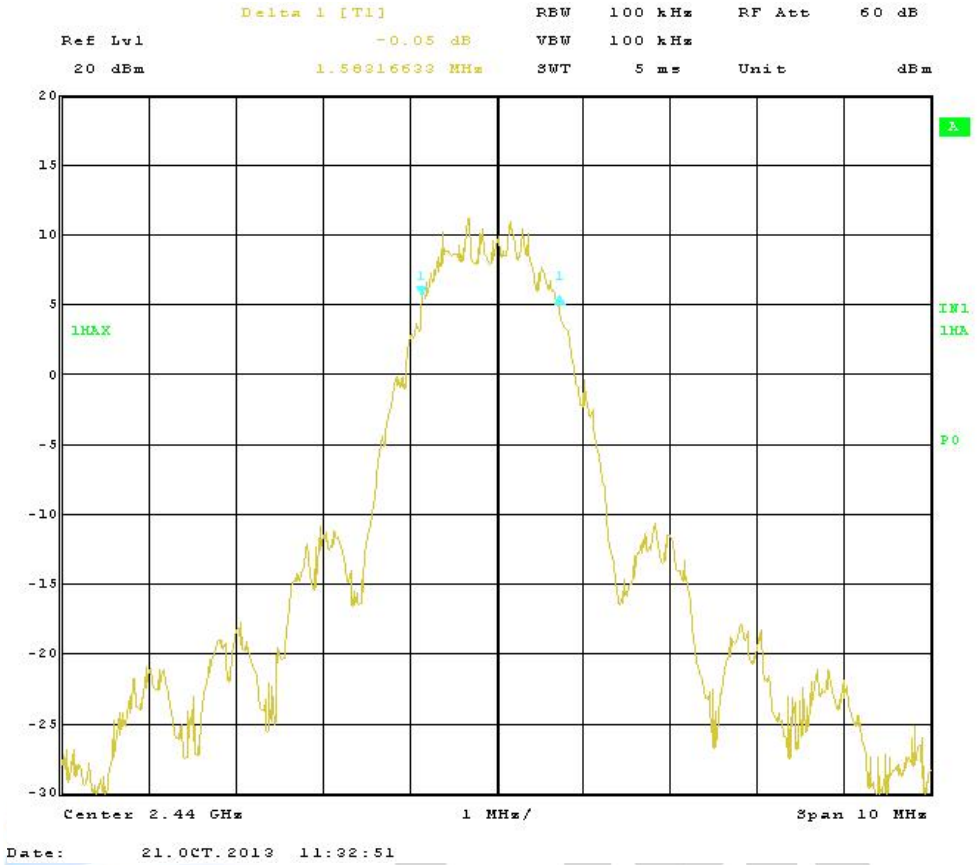
Frequency (MHz)	6 dB bandwidth (MHz)
2405.000	1.5831
2440.000	1.5831
2460.000	1.6032

Result: Complies.

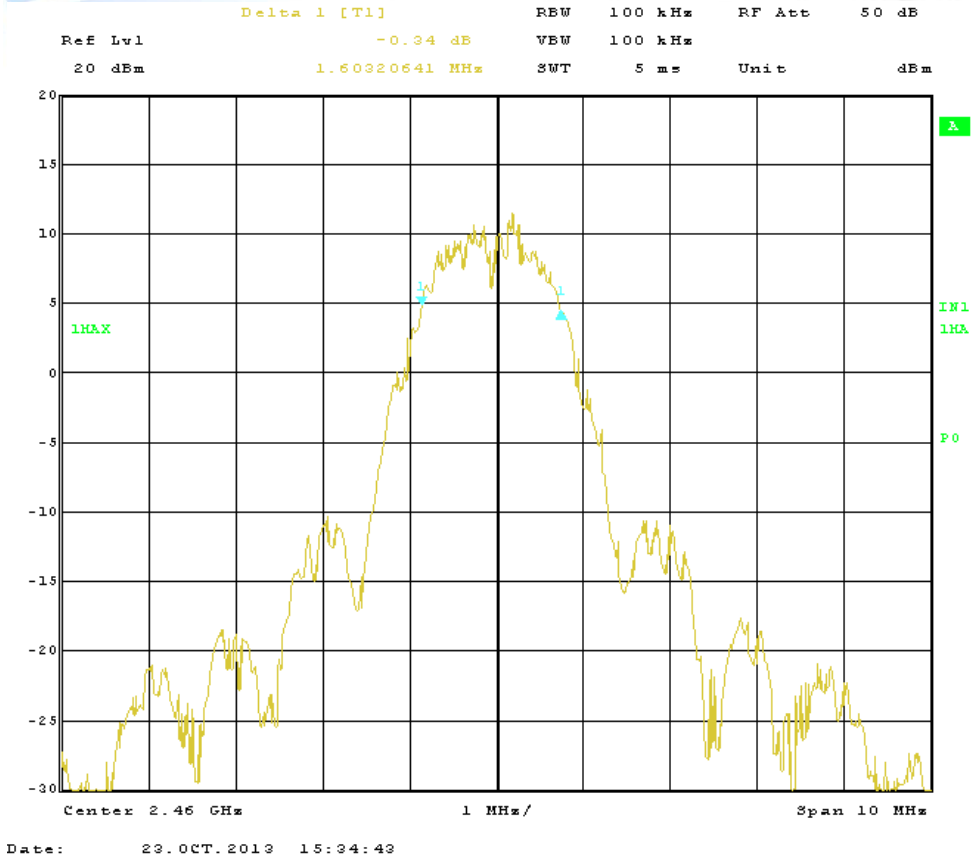
2405 MHz



2440 MHz



2460 MHz



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

Conducted and Radiated peak power measurements were carried out as the device had detachable antenna with reverse SMA antenna port connectors.

Testing was carried out by establishing a link with an active Sensor device.

Testing was carried out on 2405, 2440 and 2460 MHz as the transmitter 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 3 MHz.

Conducted power

Frequency (MHz)	Power (dBm)	Limit (dBm)	Power (watts)
2405.0000	17.1	30.0	0.051
2440.0000	17.4	30.0	0.055
2460.0000	17.3	30.0	0.053

Radiated measurements were also made to determine the antenna gain

Radiated power

Frequency (MHz)	Level (dBuV/m)	Radiated Power (dBm)	Conducted Power (dBm)	Antenna Gain (dB)
2405.000	114.1	18.8	17.1	1.7
2440.000	117.0	19.2	17.4	1.8
2460.000	116.3	18.9	17.3	1.6

The client advises that the antenna has an approximate gain of 1 dBi.

The antenna gain has been confirmed and it has been confirmed that the antenna has a gain of less than 6 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

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.

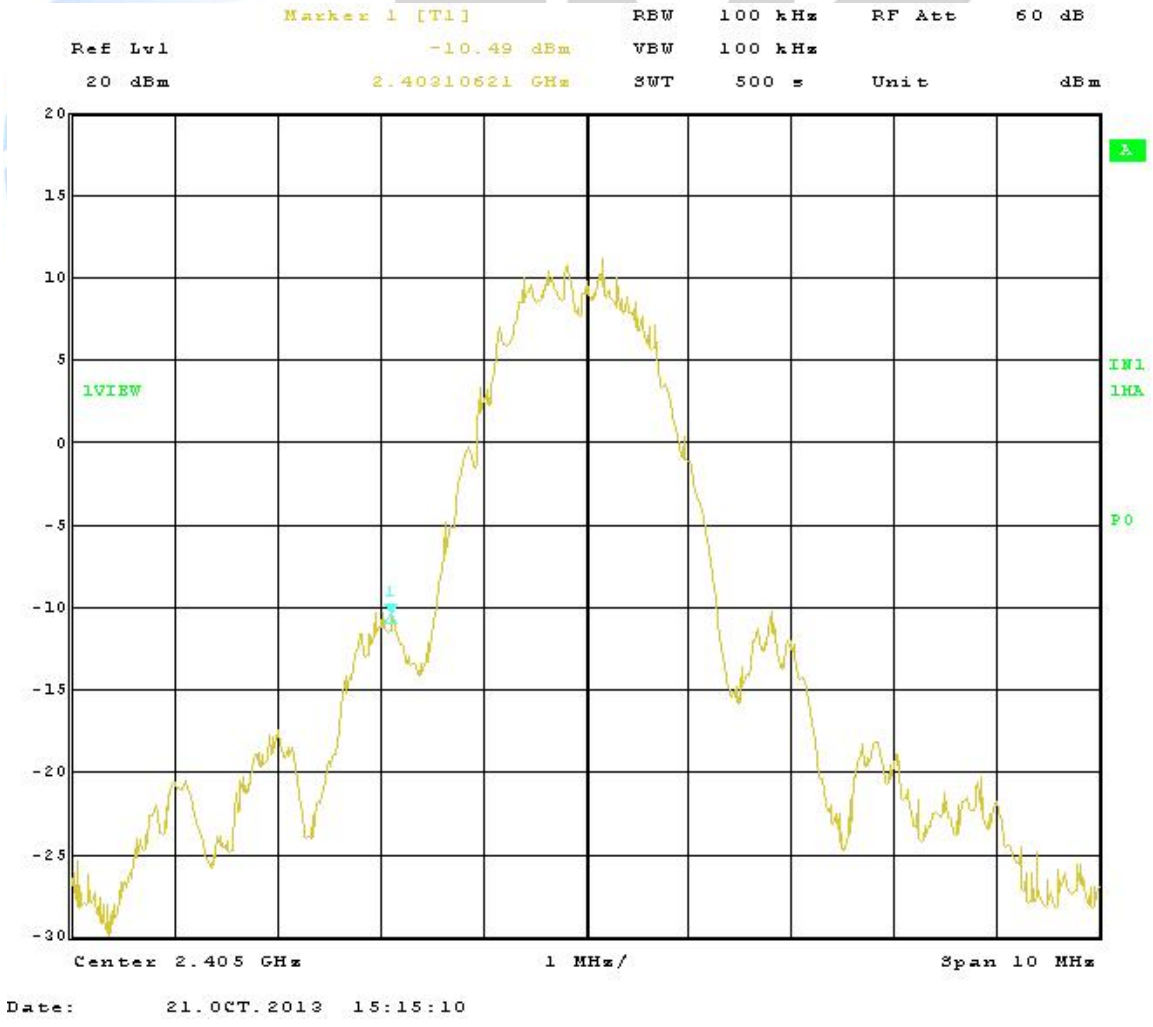
Testing was carried out at the antenna port when the device was transmitting on 2405 MHz and 2460 MHz with the -20 dB points determined as below.

20 dB band edge points

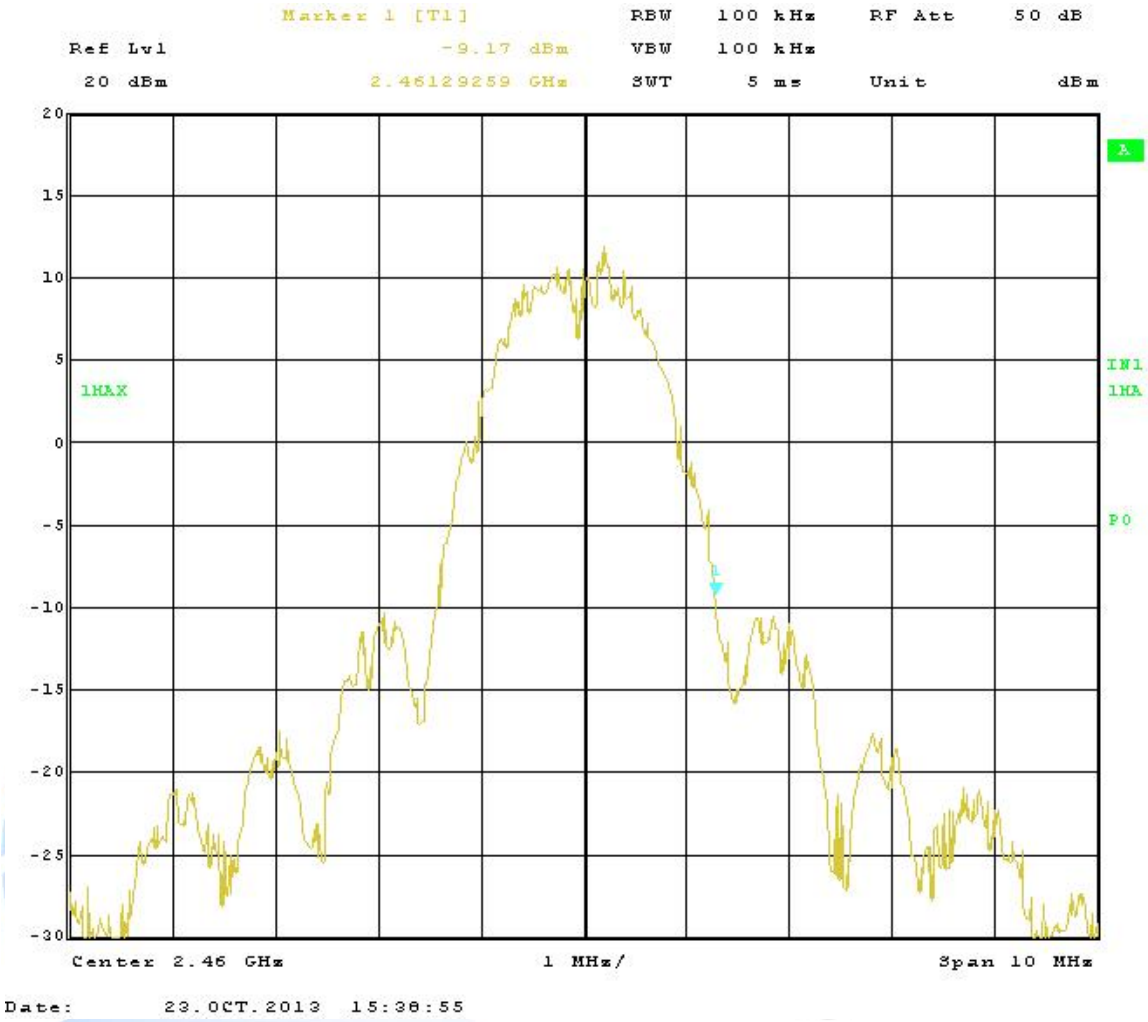
Frequency (MHz)	F low (MHz)	F high (MHz)
2405.000	2403.1062	-
2460.000	-	2461.9750

Spectrum plots showing these measurements is detailed below

2405 MHz



2460 MHz



Result: Complies.

Measurement Uncertainty: ± 1.1 dB

Section 15.247 (d) – Out of band emissions - Radiated

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

Frequency (MHz)	Vertical (dBuV/m)	Hort (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	BW	Antenna
2405.000	114.1		-	-	Peak	100 kHz	Vertical
2400.000	71.5		94.1	22.5	Peak	100 kHz	Vertical
2390.000	73.0		74.0	1.0	Peak	1 MHz	Vertical
2390.000	44.1		54.0	9.9	Average	1 MHz	Vertical
2483.500	73.0		74.0	1.0	Peak	1 MHz	Vertical
2483.000	44.1		54.0	9.9	Average	1 MHz	Vertical

The worst case antenna polarisation was 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
Measurement uncertainty: ± 4.1 dB

Conducted spurious emissions

Measurements were made at the antenna port while the transmitter was transmitting continuously using a spectrum analyser with a 100 kHz resolution bandwidth with a limit of -20 dBc being applied.

Transmitting on 2405.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)	Detector	Bandwidth (kHz)
2405.000	16.6	-	Peak	100
4810.000	-42.0	-3.4	Peak	100
7215.000	< -45.0	-3.4	Peak	100
9620.000	< -45.0	-3.4	Peak	100
12025.000	< -45.0	-3.4	Peak	100
14430.000	< -45.0	-3.4	Peak	100
16835.000	< -45.0	-3.4	Peak	100
19240.000	< -45.0	-3.4	Peak	100
21645.000	< -45.0	-3.4	Peak	100
21645.000	< -45.0	-3.4	Peak	100

Transmitting on 2440.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)	Detector	Bandwidth (kHz)
2440.000	16.8	-	Peak	100
4880.000	-41.6	-3.2	Peak	100
7320.000	< -45.0	-3.2	Peak	100
9760.000	< -45.0	-3.2	Peak	100
12200.000	< -45.0	-3.2	Peak	100
14640.000	< -45.0	-3.2	Peak	100
17080.000	< -45.0	-3.2	Peak	100
19520.000	< -45.0	-3.2	Peak	100
21960.000	< -45.0	-3.2	Peak	100
24400.000	< -45.0	-3.2	Peak	100

Transmitting on 2460.000 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)	Detector	Bandwidth (kHz)
2460.000	16.7	-	Peak	100
4940.000	-39.4	-3.3	Peak	100
7410.000	< -45.0	-3.3	Peak	100
9880.000	< -45.0	-3.3	Peak	100
12350.000	< -45.0	-3.3	Peak	100
14820.000	< -45.0	-3.3	Peak	100
17290.000	< -45.0	-3.3	Peak	100
19760.000	< -45.0	-3.3	Peak	100
22230.000	< -45.0	-3.3	Peak	100
24700.000	< -45.0	-3.3	Peak	100

Result: Complies
Measurement uncertainty: ± 1.1 dB

Radiated spurious emissions and restricted band emission measurements

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

Radiated emission measurements were carried out with the limits as per section 15.209 applied to all emissions, even those that that fell within the restricted bands, as a worst case scenario.

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 attempted at 3 metres from the device with no emission being detected.

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

Result: Complies
Measurement uncertainty: ± 4.1 dB

Transmitting continuously on 2405.0 MHz

Freq (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Result	Detector
4810.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
4810.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
7215.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
7215.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
9620.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
9620.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
12025.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
12025.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
14430.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
14430.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
16835.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
16835.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
19240.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
19240.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
21645.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
21645.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
24050.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
24050.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average

No other spurious emissions were observed except for the harmonic emissions observed above.

Transmitting continuously on 2440.0 MHz

Freq (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Result	Detector
4880.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
4880.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
7320.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
7320.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
9760.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
9760.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
12200.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
12200.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
14640.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
14640.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
17080.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
17080.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
19520.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
19520.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
21960.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
21960.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
24400.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
24400.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average

No other spurious emissions were observed except for the harmonic emissions observed above.

Transmitting continuously on 2460.0 MHz

Freq (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Result	Detector
4920.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
4920.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
7380.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
7380.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
9840.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
9840.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
12300.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
12300.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
14760.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
14760.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
17220.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
17220.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
19680.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
19680.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
22140.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
22140.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average
24600.0	< 59.0	< 59.0	74.0	-	Vert/Hort	Pass	Peak
24600.0	< 46.0	< 46.0	54.0	-	Vert/Hort	Pass	Average

No other spurious emissions were observed except for the harmonic emissions observed above.

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 directly at the antenna port.

Frequency (MHz)	Level (dBm)	Antenna (dBi)	Density (dBm)	Limit (dBm)
2404.9985	4.7	1.7	7.4	8.0
2439.9955	4.9	1.8	7.7	8.0
2459.9995	4.9	1.6	7.5	8.0

Result: Complies.
Measurement Uncertainty: ± 4.1 dB

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/cm^2 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, V/m = (√ (30 * P * G)) / d
Power density, mW/cm^2 = E2/3770
E for MPE: 1 = E^2/3770
E = √1*3770
E = 61.4 V/m

The highest radiated power has been measured to be +19.6 dBm or 0.091 watts EiRP when operating on 2440.0 MHz

Therefore:
E = √ (30 * P * G) / d
d = √ (30 * P * G) / E
d = √ (30 * 0.09) / 61.4
d = 0.027 m or 2.7 cm

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

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Interval
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	27 June 2015	2 year
Mains Network	R & S	ESH2-Z5	881362/032	3628	23 Oct 2016	2 year
Receiver	R & S	ESIB 40	100171	R-27-1	29 Jan 2015	1 year
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	7 July 2015	1 year
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2015	1 year
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2015	1 year
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2015	1 year
Horn Antenna	EMCO	3115	9511-4629	E1526	4 June 2017	3 year
Horn Antenna	EMCO	3116	92035	-	4 June 2017	3 year
Loop Antenna	EMCO	6502	9003-2485	3798	4 July 2017	3 year

At the time of testing all test equipment was within calibration

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 last updated in June 2014.

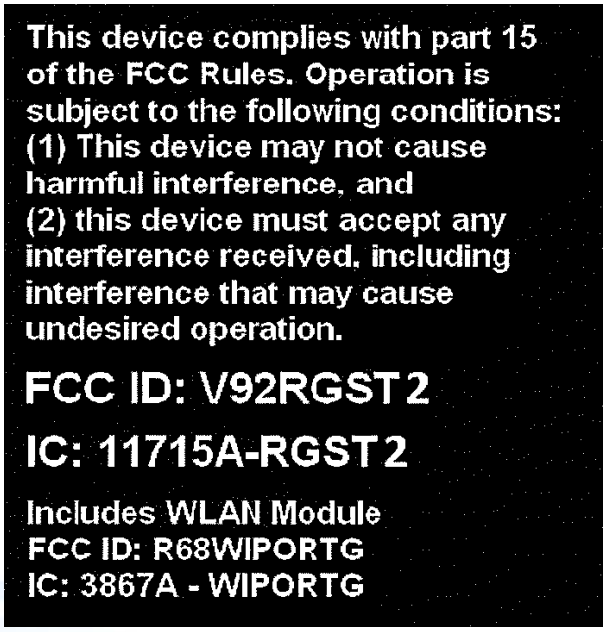
All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

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.

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.

9. PHOTOGRAPHS

External Photos - New Label

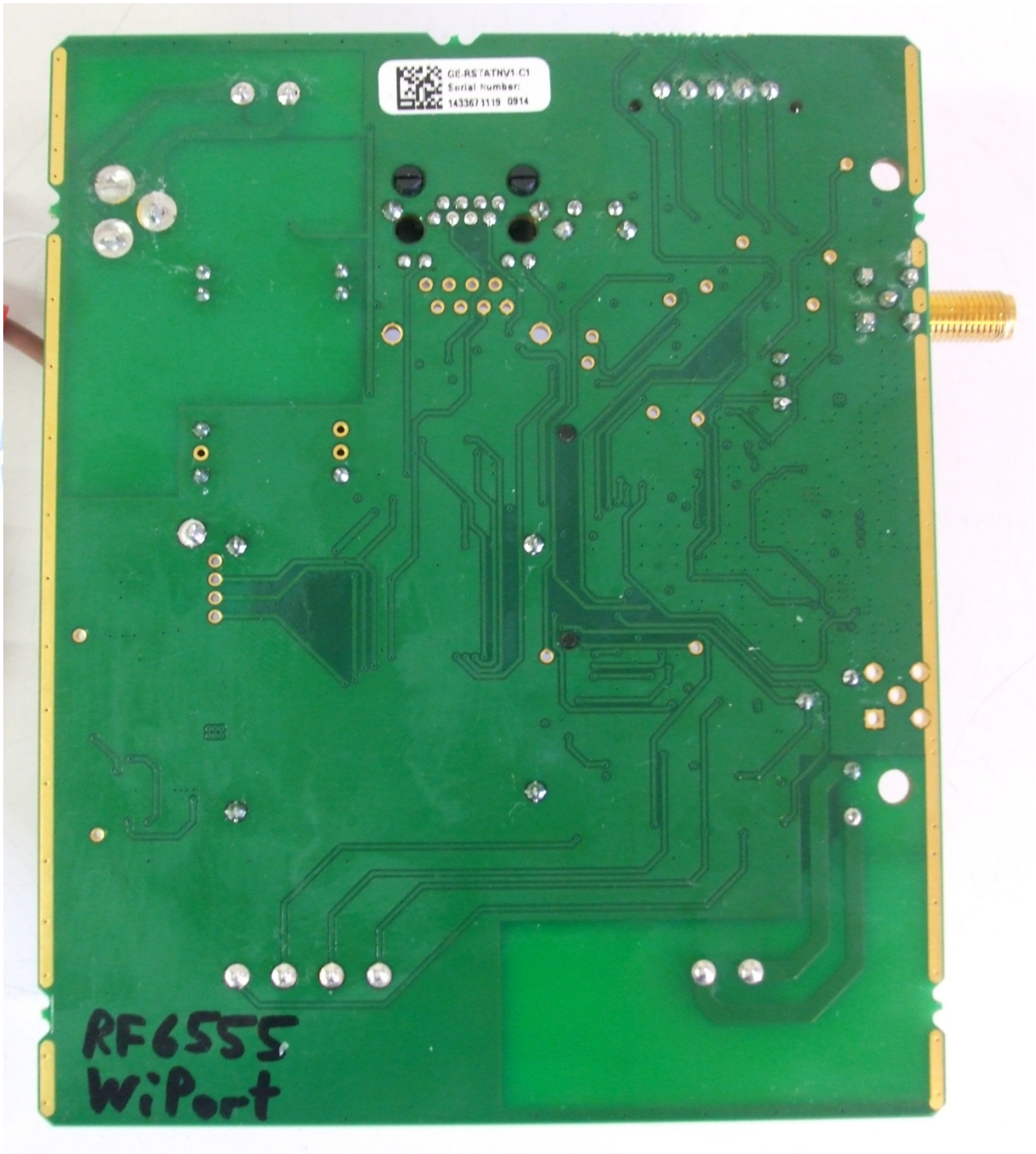


Test sample with new label

Test sample with old label

Antenna Connector (Reverse SMA)

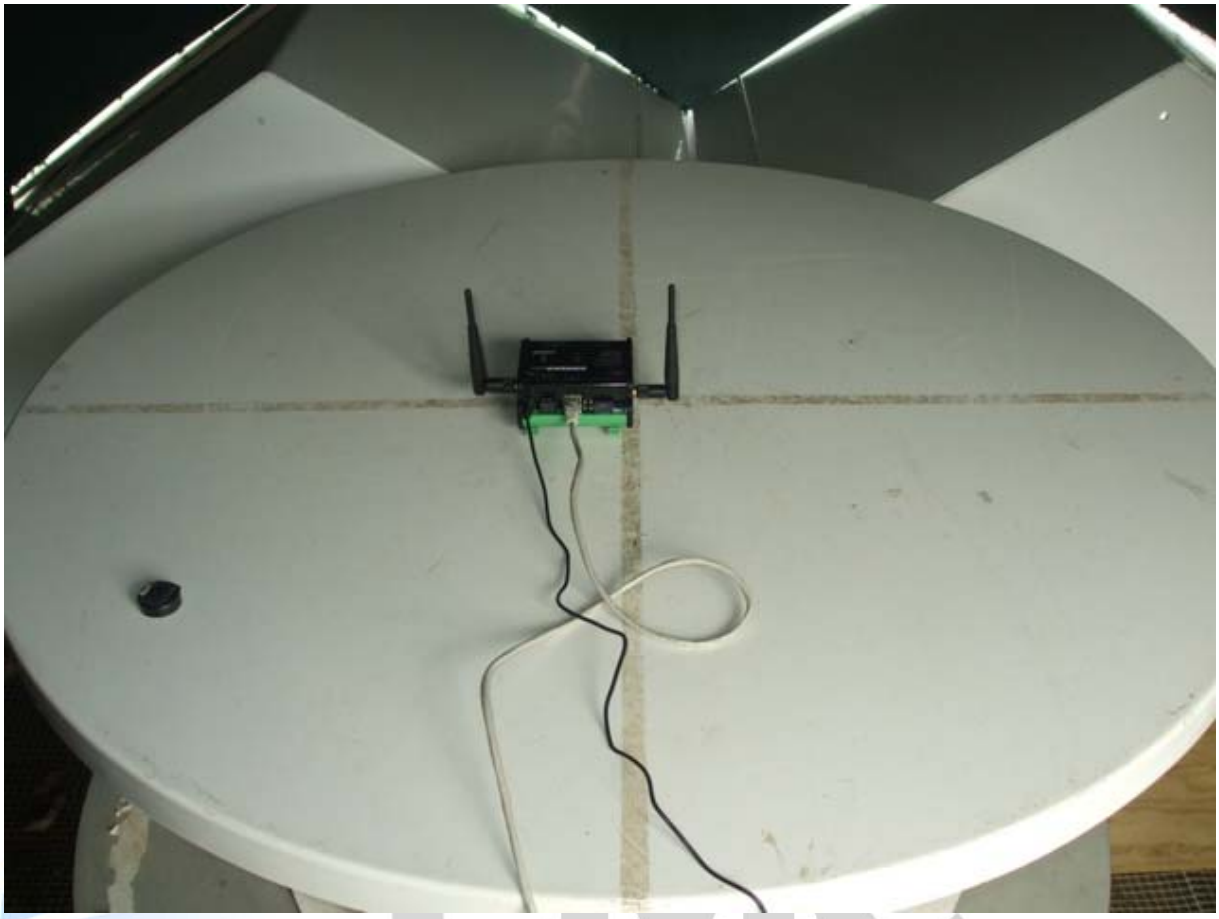
Internal Photos

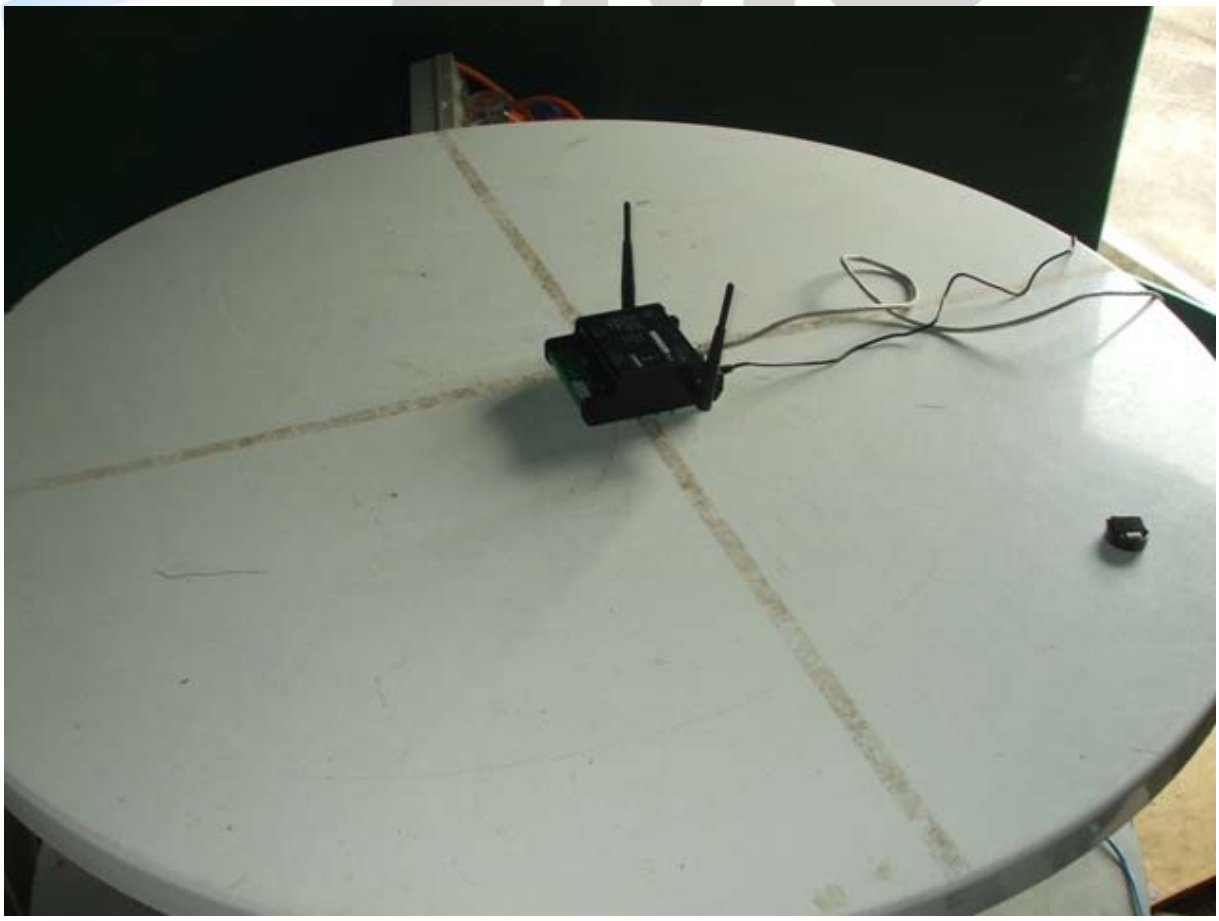


Radiated emissions test set up photos – Below 30 MHz

Radiated emissions test set up photos – Above 30 MHz

Radiated emissions test set up photos





Conducted emission tests set up photos