EMC Technologies (NZ) Ltd

Test Report No **100726.1**
Report date: 12 August 2010

TEST REPORT

Cooper Crouse-Hinds Smart Switch 802.15.4 Radio

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

ELPRO Technologies PTY 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 **Cooper Crouse-Hinds SmartSwitch 802.15.4 Radio** 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

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	ELPRO Technologies PTY Ltd
Address	9/12 Billabong Street Stafford
State	Queensland
Country	Australia
Contact	Mr Scott Bowman

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Cooper Crouse-Hinds
Model Number	SmartSwitch
Product	802.15.4 Radio
Manufacturer	ELPRO Technologies PTY Ltd
Country of Origin	Australia
Serial Number	05101252
FCC ID	O9P-SS1

Device description

The device that was tested has the following specifications:

Modulation type:	OFDM using 802.15.4 protocols
Operating voltage:	24 Vdc
Rate Output power:	25 mW (+14.0 dBm) approximately
Antennas:	S2406BFNM with 1 m of LMR100 Cable. Overall gain 6.5 dBi
	N24-5-NM-B directly connected. Overall gain 5 dBi
FCC band:	2400 – 2483.5 MHz
Operating channels:	16 channels with 5 MHz spacing between 2405 MHz and 2475 MHz
Operating frequencies:	16 MHz multiplied to 48 MHz (Atmel microprocessor AT91SAM7)
	550 kHz (Switch mode regulator LM2841X)

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 802.15.4 transmitter.

Section 15.203: Antenna requirement

This device has an antenna port with a standard N type connector which is not unique.

Given the type of device the user manual will state that this device must be installed by an experienced radio and antenna installer using only antennas that are supplied by the manufacturer.

Device was tested with the following antennas:

- S2406BFNM whip antenna with 1 m length of LMR100 Cable. Overall gain 6.5 dBi

- N24-5-NM-B whip antenna directly connected to the device. Overall gain 5 dBi

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 15.207: 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 external 110 Vac to 24 Vdc power suuply.

The device can operate over a power supply range of 9 – 30 Vdc.

Testing was carried out using a 24 Vdc supply as this was deemed to be the worst case set up.

The transmitter in this device operates in the 2400 – 2483.5 MHz band.

Testing was carried out when the device was transmitting and receiving continuously.

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.

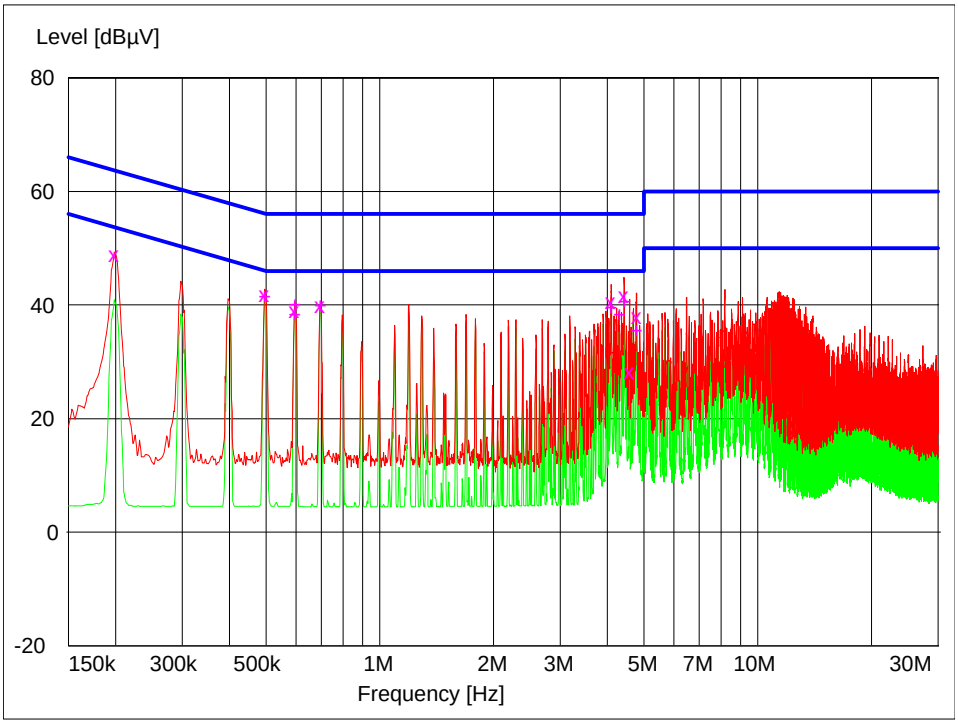
Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- AC Mains port (0.15-30 MHz) ± 2.8 dB

Conducted Emissions – AC Mains Port

Setup:	Device tested when transmitting continuously when powered at 120 Vac using a representative AC power supply supplying 24Vdc.

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.198000	48.90	63.7	14.8	L1	
0.495000	41.90	56.1	14.2	L1	
0.594000	39.00	56.0	17.0	L1	
0.696000	40.00	56.0.	16.0	L1	
4.097000	40.60	56.0	15.4	L1	
4.430000	41.80	56.0	14.2	L1	
4.578500	28.30	56.0	27.7	L1	
4.781000	37.90	56.0	18.1	L1	

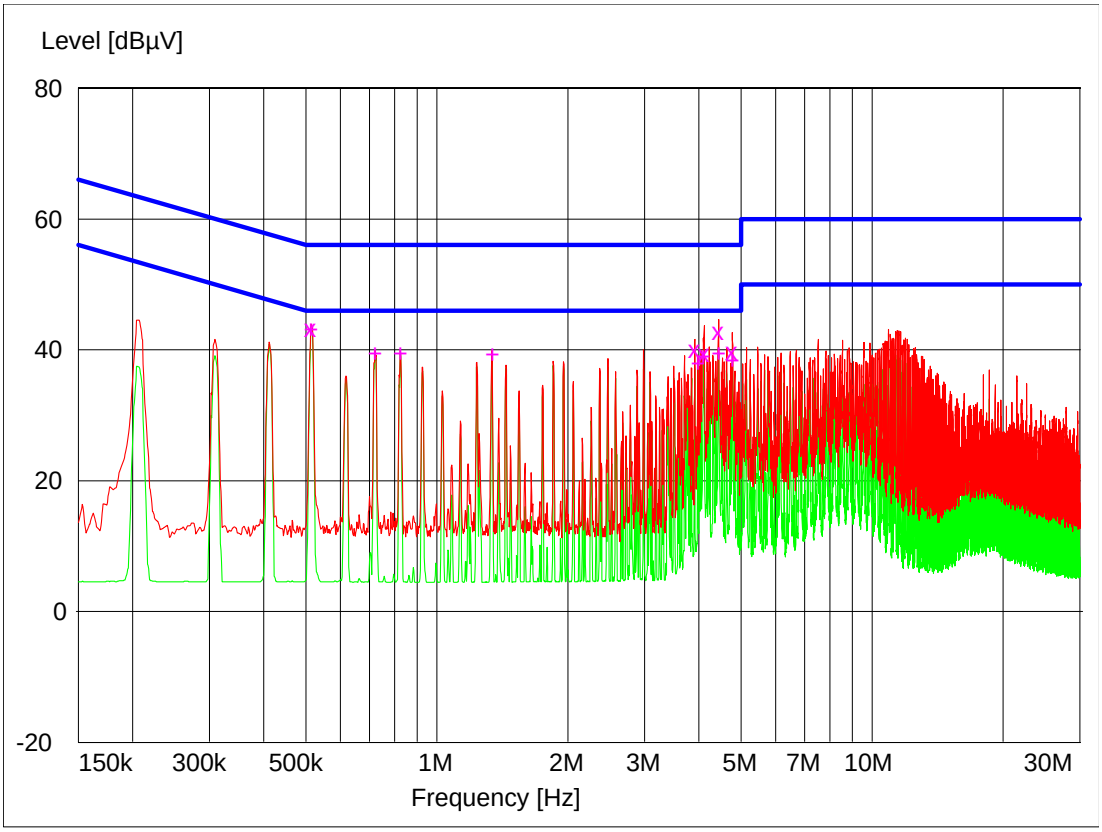
Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.495000	41.50	46.1	4.6	L1	
0.594000	38.40	46.0	7.6	L1	
0.597000	40.20	46.0	5.9	L1	
0.696000	39.90	46.0	6.1	L1	
4.092500	39.60	46.0	6.4	L1	
4.299500	38.40	46.0	7.6	L1	
4.434500	40.60	46.0	5.4	L1	
4.772000	35.60	46.0	10.4	L1	

Conducted Emissions – AC Mains Port

Setup:	Device tested operating in receive mode when powered using a representative ac power supply at 120 Vac.

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.513000	43.30	56.0	12.7	L1	
3.912500	40.10	56.0	16.0	L1	
4.110500	39.40	56.0	16.6	L1	
4.439000	42.80	56.0	13.3	L1	
4.772000	39.80	56.0	16.2	L1	

Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.513000	43.20	46.0	2.8	L1	
0.720000	39.50	46.0	6.5	L1	
0.822000	39.50	46.0	6.5	L1	
1.338000	39.30	46.0	6.7	L1	
3.975500	38.00	46.0	8.0	L1	
4.092500	39.00	46.0	7.0	L1	
4.434500	39.50	46.0	6.5	L1	
4.776500	38.30	46.0	7.7	L1	

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.

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 continuous transmit mode and also in receive mode.

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 with a 1 MHz resolution bandwidth.

The spurious emissions observed do not exceed the level of the fundament 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 with measurements being made 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)

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

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

Radiated Emissions

The device was tested laying flat on top of the test table with the small whip antenna vertical.

The device was powered using a representative AC power supply at 24 Vdc that was powered at 110 Vac.

Attached to the device was a laptop computer that was attached to serial port.

The device was tested on discrete frequencies using customer supplied control codes

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
59.583	30.1		40.0	9.9	Quasi Peak	Vertical
60.740		25.8	40.0	14.2	Quasi Peak	Horizontal
84.712		26.8	43.5	16.7	Quasi Peak	Horizontal
135.870	34.7		43.5	8.8	Quasi Peak	Vertical
137.435		37.4	43.5	6.1	Quasi Peak	Horizontal
240.000	32.8		46.0	13.2	Quasi Peak	Vertical
253.720	28.3		46.0	17.7	Quasi Peak	Vertical
325.000		33.0	46.0	13.0	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.

Section 15.247(a)(2): Minimum bandwidth

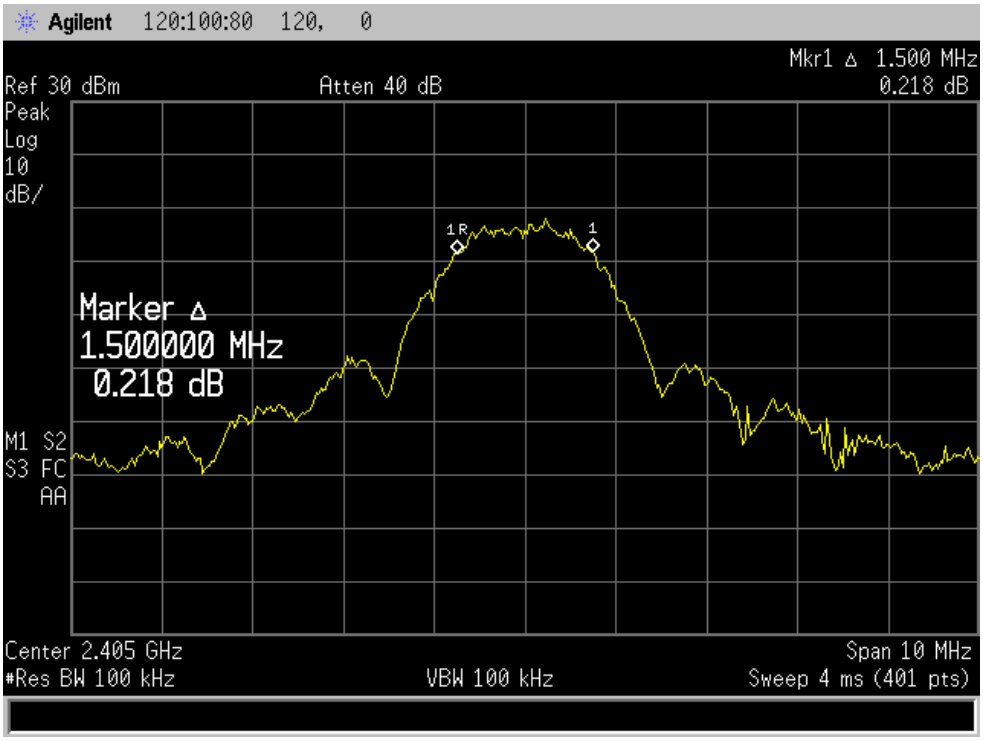
This systems using digital modulation techniques shall have a minimum 6 dB bandwidth of 500 kHz

Testing was carried on 2405 MHz, 2440 MHz and 2475 MHz with the following results:

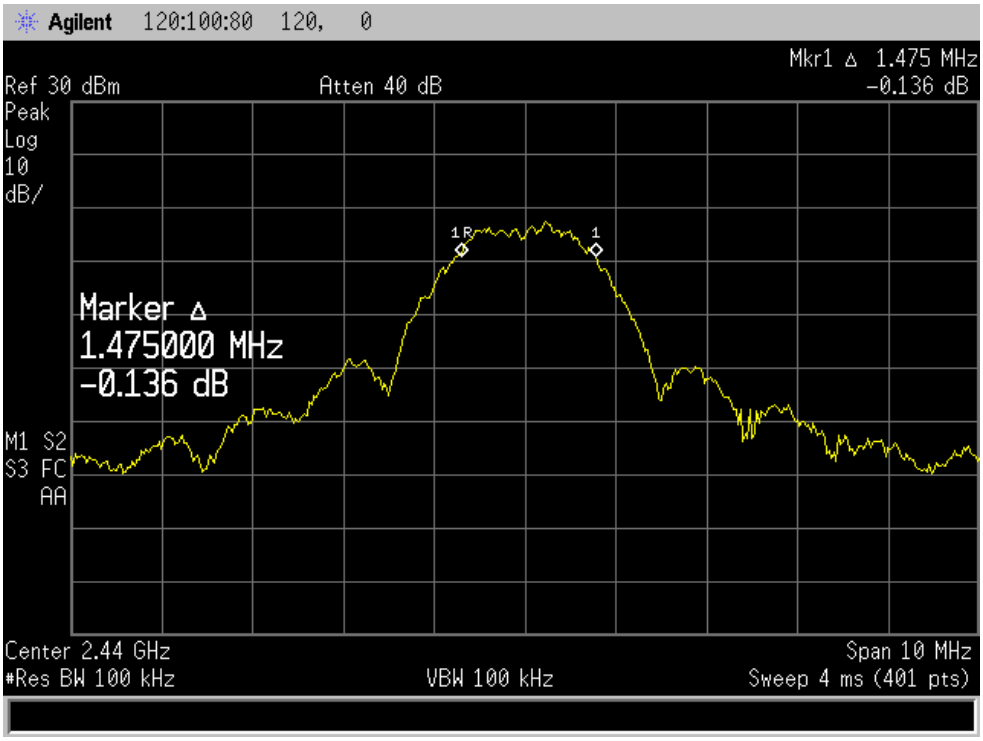
Frequency (MHz)	6 dB bandwidth (MHz)
2405.000	1.5000
2440.000	1.4750
2475.000	1.6000

Result: Complies

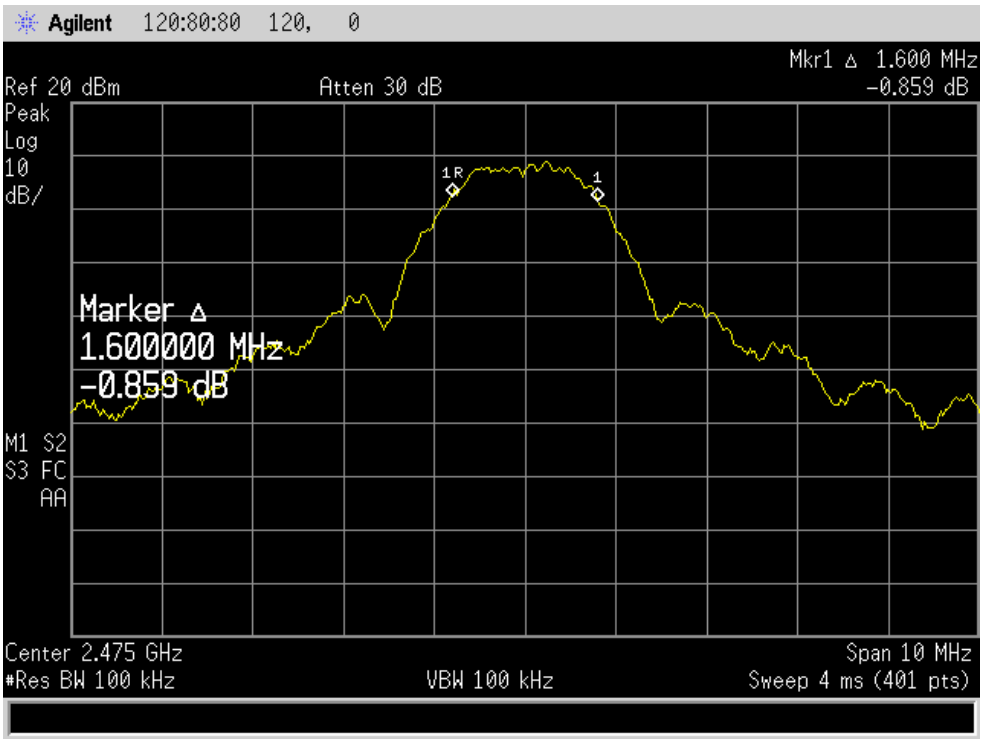
2405 MHz



2440 MHz



2475 MHz



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

Conducted peak power measurements were made as the antenna port using a spectrum analyser operating in peak hold with a resolution bandwidth of 3 MHz with the transmitter set up to operate on discrete frequencies.

Frequency (MHz)	Power (dBm)	Power (watts)	Limit (watts)
2405.000	15.6	0.036	1.0
2440.000	15.4	0.035	1.0
2475.000	14.9	0.031	1.0

The input dc voltage to the device was varied between 9 Vdc – 30 Vdc which showed no variation in output power.

Testing was carried out at the test site using the antennas supplied by the client to confirm this as detailed below.

Testing was carried out on three channels being 2405.000 MHz, 2440.000 MHz and 2475.000 MHz.

Measurements were made using a spectrum analyser with a resolution bandwidth of 3 MHz when the transmitter was setup to operate on discrete frequencies.

N24-5-NM-B whip antenna

Frequency (MHz)	Field Strength (dBuV/m)	Radiated Power (dBm)	Antenna Gain (dBi)	Transmitter Power (dBm)	Limit (dBm)
2405.000	115.8	20.6	5.0	15.6	30.0
2440.000	115.1	19.9	5.0	14.9	30.0
2475.000	114.1	18.9	5.0	13.9	30.0

S2406BFNM whip antenna with 1 m length of LMR100 Cable

Frequency (MHz)	Field Strength (dBuV/m)	Radiated Power (dBm)	Antenna Gain (dBi)	Transmitter Power (dBm)	Limit (dBm)
2405.000	116.3	21.1	6.5	14.6	30.0
2440.000	116.5	21.3	6.5	14.8	30.0
2475.000	116.7	21.5	6.5	15.0	30.0

A 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.

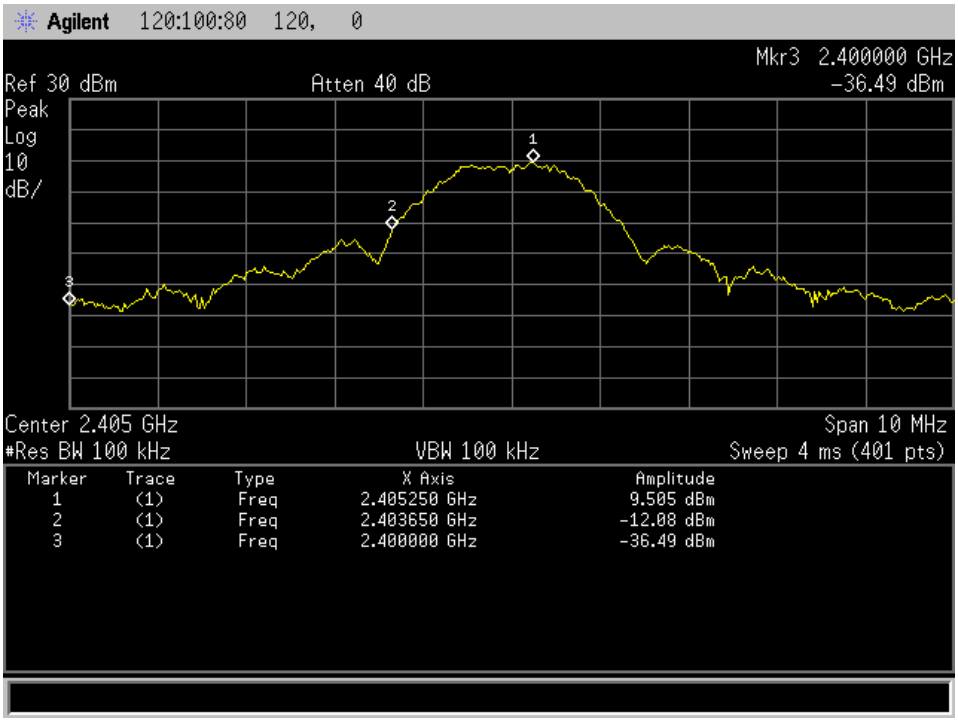
Testing was carried out when the device was transmitting on 2405 MHz and 2475 MHz with the -20 dB points determined as below.

20 dB bandwidth points

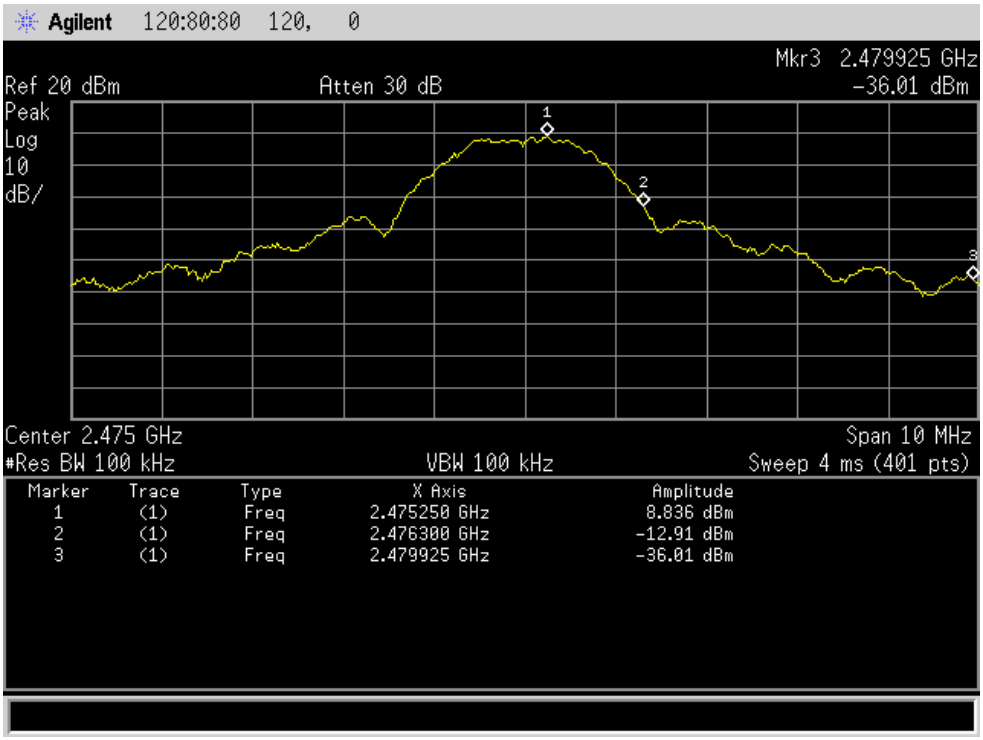
Frequency (MHz)	F low (MHz)	F high (MHz)
2405.000	2403.6500	-
2475.000	-	2476.3000

Spectrum plots showing these measurements is detailed below

2405 MHz



2475 MHz



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

N24-5-NM-B whip antenna directly connected to the device

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	RBW	Antenna
2405.000	107.5	99.7	-	-	Peak	100 kHz	Vertical
2400.000	62.5		87.5	25.0	Peak	100 kHz	Vertical
2400.000		54.0	79.7	25.7	Peak	100 kHz	Horizontal
2390.000	63.5	55.0	74.0	10.5	Peak	1 MHz	Vertical
2390.000	42.8	40.9	54.0	11.2	Average	1 MHz	Vertical
2475.000	105.4	94.1	-	-	Peak	100 kHz	Vertical
2483.500	64.5	54.0	74.0	9.5	Peak	1 MHz	Vertical
2483.500	44.2	41.8	54.0	9.8	Average	1 MHz	Vertical

S2406BFNM whip antenna with 1 m length of LMR100 Cable

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	RBW	Antenna
2405.000	108.9	100.5	-	-	Peak	100 kHz	Vertical
2400.000	63.4		88.9	25.5	Peak	100 kHz	Vertical
2400.000		54.9	80.5	25.6	Peak	100 kHz	Horizontal
2390.000	64.7	56.1	74.0	9.3	Peak	1 MHz	Vertical
2390.000	43.4	42.5	54.0	10.6	Average	1 MHz	Vertical
2475.000	109.5	98.4	-	-	Peak	100 kHz	Vertical
2483.500	66.5	59.1	74.0	7.5	Peak	1 MHz	Vertical
2483.500	44.1	41.3	54.0	9.9	Average	1 MHz	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 2475 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

Spurious emissions and restricted band radiated emission measurements

Conducted spurious emission measurements were made at the antenna port using a spectrum analyser with a 100 kHz resolution bandwidth on the three frequencies described below.

A limit of -20 dBc has been applied relative to the fundamental transmit frequency.

All other emissions observed had a margin to the limit that exceeded 20 dB.

Transmitting on 2405 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
2405.000	9.3	
4810.000	-71.5	-10.7
7215.000	-71.3	-10.7
9620.000	-74.5	-10.7
12025.000	-66.9	-10.7
14430.000	< -70.0	-10.7
16835.000	< -70.0	-10.7
19240.000	< -70.0	-10.7
21645.000	< -70.0	-10.7
24050.000	< -70.0	-10.7

Transmitting on 2440 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
2440.000	8.7	
4880.000	-70.5	-11.3
7320.000	-67.3	-11.3
9760.000	-68.3	-11.3
12200.000	-66.5	-11.3
14640.000	< -70.0	-11.3
17080.000	< -70.0	-11.3
19520.000	< -70.0	-11.3
21960.000	< -70.0	-11.3
24400.000	< -70.0	-11.3

Transmitting on 2475 MHz

Frequency (MHz)	Level (dBm)	Limit (dBm)
2475.000	8.8	
4950.000	-73.1	-11.2
7425.000	-62.6	-11.2
9900.000	-74.6	-11.2
12375.000	-64.8	-11.2
14850.000	< -70.0	-11.2
17325.000	< -70.0	-11.2
19800.000	< -70.0	-11.2
22275.000	< -70.0	-11.2
24750.000	< -70.0	-11.2

Radiated measurements were also made as 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 in both vertical and horizontal antenna polarisations.

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

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

2405.000 MHz harmonic emissions observed when the S2406BFNM whip antenna with 1 m length of LMR100 Cable was attached.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4810.000	62.0	55.0	74.0	12.0	Peak	Vertical
4810.000	44.0	43.0	54.0	10.0	Average	Vertical
7215.000	68.4	55.0	74.0	5.6	Peak	Vertical
7215.000	49.0	43.0	54.0	5.0	Average	Vertical
9620.000	59.0	58.0	74.0	15.0	Peak	Vertical
9620.000	46.0	46.0	54.0	8.0	Average	Horizontal
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

2440.000 MHz harmonic emissions observed when the S2406BFNM whip antenna with 1 m length of LMR100 Cable was attached.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4880.000	62.0	59.0	74.0	12.0	Peak	Vertical
4880.000	45.0	42.5	54.0	9.0	Average	Vertical
7320.000	66.5	62.1	74.0	7.5	Peak	Vertical
7320.000	50.1	44.0	54.0	3.9	Average	Vertical
9760.000	59.0	58.0	74.0	15.0	Peak	Vertical
9760.000	46.0	46.0	54.0	8.0	Average	Vertical
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

2475.000 MHz harmonic emissions observed when the S2406BFNM whip antenna with 1 m length of LMR100 Cable was attached.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4920.000	56.0	50.1	74.0	18.0	Peak	Vertical
4920.000	43.0	42.1	54.0	9.0	Average	Horizontal
7380.000	67.4	61.3	74.0	6.6	Peak	Vertical
7380.000	48.0	46.0	54.0	6.0	Average	Vertical
9840.000	59.0	58.0	74.0	15.0	Peak	Vertical
9840.000	46.0	46.0	54.0	8.0	Average	Vertical
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

2405.000 MHz harmonic emissions observed when the N24-5-NM-B whip antenna directly connected to the device

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4810.000	58.5	51.8	74.0	15.5	Peak	Vertical
4810.000	43.0	38.5	54.0	11.0	Average	Vertical
7215.000	67.3	63.3	74.0	6.7	Peak	Vertical
7215.000	48.2	46.6	54.0	5.8	Average	Vertical
9620.000	59.0	58.0	74.0	15.0	Peak	Vertical
9620.000	46.0	46.0	54.0	8.0	Average	Horizontal
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

2440.000 MHz harmonic emissions observed when the N24-5-NM-B whip antenna directly connected to the device

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4880.000	62.0	55.0	74.0	12.0	Peak	Vertical
4880.000	44.0	43.0	54.0	10.0	Average	Vertical
7320.000	68.4	55.0	74.0	5.6	Peak	Vertical
7320.000	49.0	43.0	54.0	5.0	Average	Vertical
9760.000	59.0	58.0	74.0	15.0	Peak	Vertical
9760.000	46.0	46.0	54.0	8.0	Average	Vertical
12200.000	63.0	63.0	74.0	11.0	Peak	Vertical
12200.000	51.0	50.0	54.0	3.0	Average	Vertical
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

2475.000 MHz harmonic emissions observed when the N24-5-NM-B whip antenna directly connected to the device

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Detector	Antenna
4920.000	62.0	52.1	74.0	12.0	Peak	Vertical
4920.000	45.0	42.5	54.0	9.0	Average	Horizontal
7380.000	66.9	61.3	74.0	7.1	Peak	Vertical
7380.000	50.0	47.6	54.0	4.0	Average	Vertical
9840.000	59.0	58.0	74.0	15.0	Peak	Vertical
9840.000	46.0	46.0	54.0	8.0	Average	Horizontal
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 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

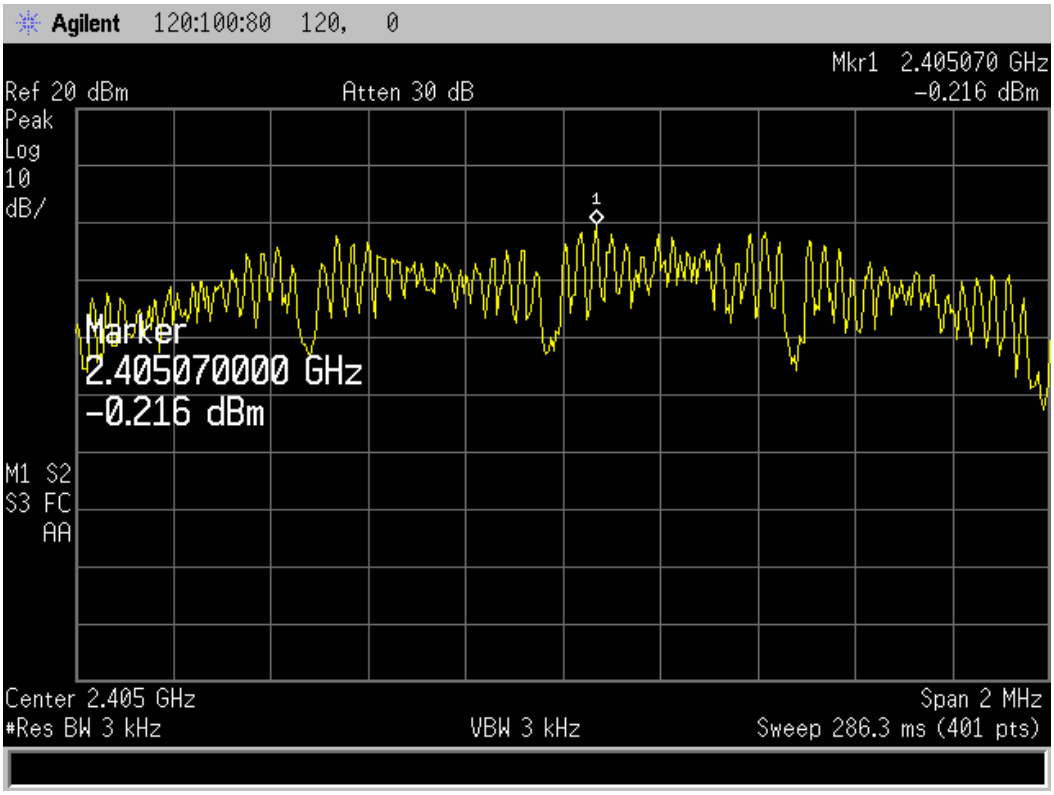
Section 15.247 (e) – Power Spectral Density

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.

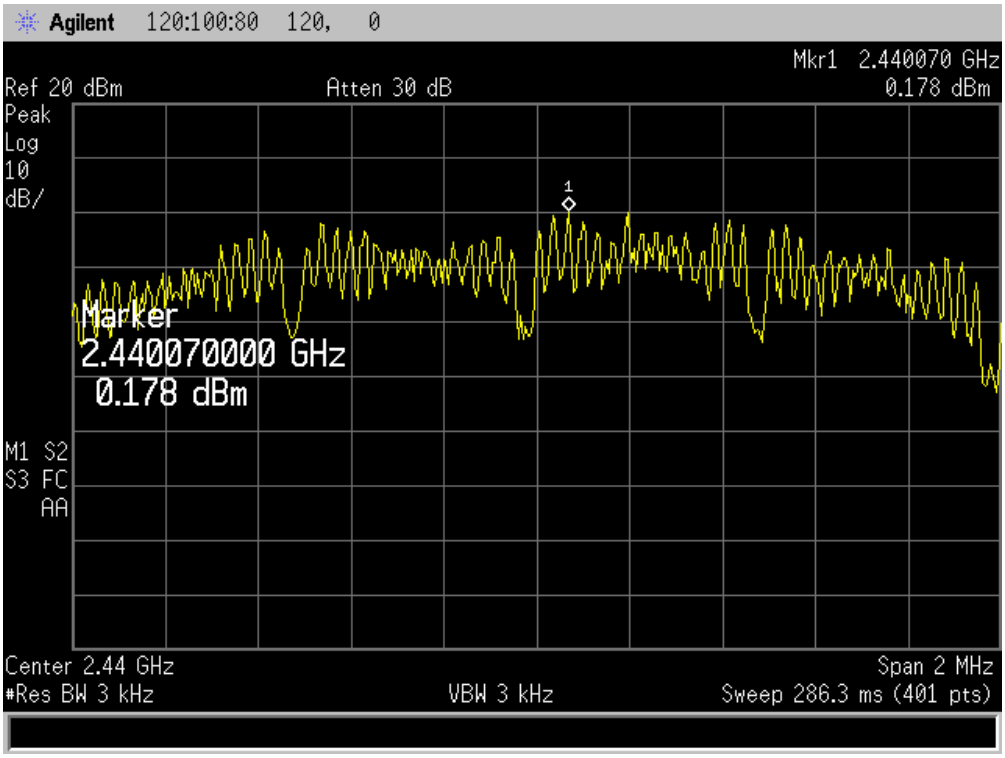
Conducted measurements have been made at the antenna port using a spectrum analyser with a resolution bandwidth of 3 kHz as detailed below.

Frequency (MHz)	Density (dBm)	Limit (dBm)
2405.5300	-0.2	8.0
2440.0700	+0.2	8.0
2475.0750	-0.2	8.0

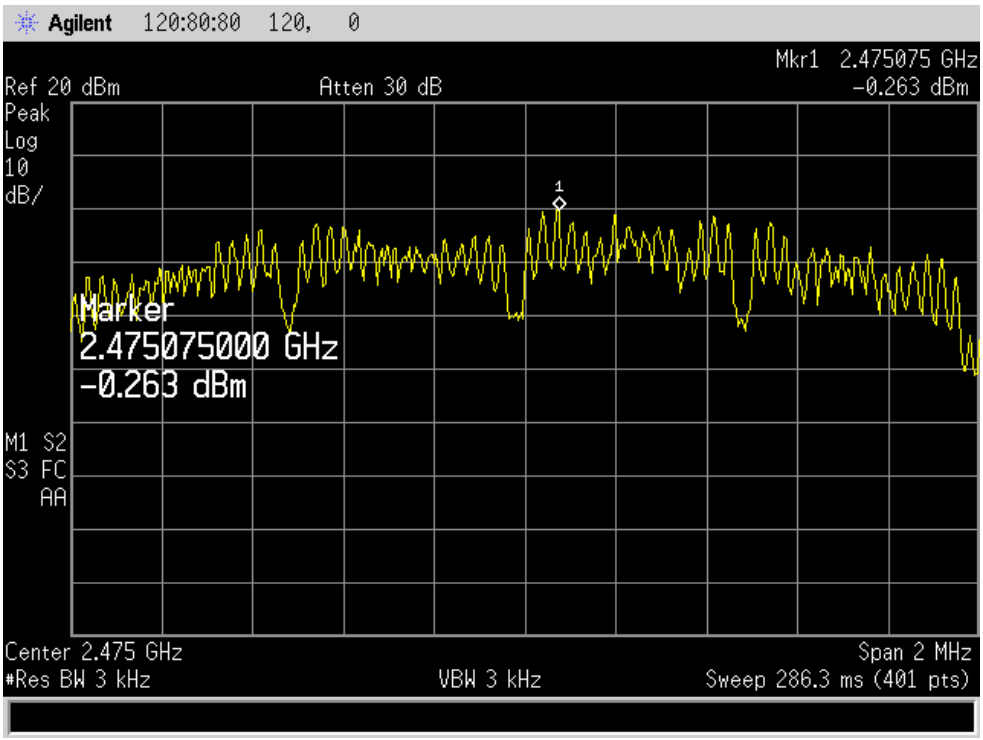
2405 MHz



2440 MHz



2475 MHz



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.

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, V/m = (√ (30 * P * G)) / d
Power density, mW/cm2 = E2/3770
E for MPE: 1 = E2/3770
E = √1*3770
E = 61.4 V/m

The highest conducted power has been measured to be +15.6 dBm or 0.036 watts.

Attached to the transmitter will be a S2406BFNM whip antenna with 1 m of LMR100 cable giving an overall gain 4.47 (6.5 dBi) which is the highest gain of the antennas supplied.

Therefore:
E = √ (30 * P * G) / d
d = √ (30 * P * G) / E
d = √ (30 * 0.036 * 4.47) / 61.4
d = 0.036 m or 3.6 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
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	N/a
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	N/a
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3613	30 Jan 2011
Receiver	R & S	ESCS 30	847124/020	E1595	7 Apr 2011
Receiver	R & S	ESIB-40	100171	R-27-1	10 Jun 2011
Receiver	R & S	ESHS 10	828404/005	RFS 3728	2 Sep 2010
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776	14 Sep 2010
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	30 Jan 2011
Horn Antenna	EMCO	3115	9511-4629	E1526	3 May 2011
Horn Antenna	EMCO	3116	92035	-	16 Jun 2011
Mains Network	R & S	ESH2-Z5	881362/034	3628	29 Jul 2012
Variac	General Radio	1592	-	RFS 3690	N/a
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/a
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3613	30 Jan 2011

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.

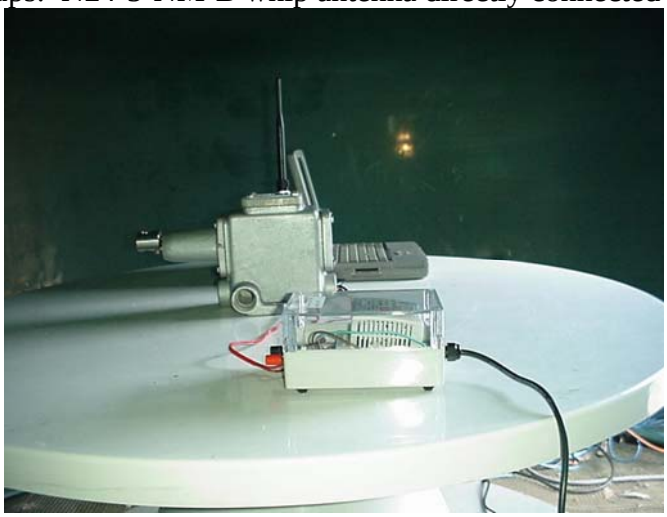
All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025, 2005

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.

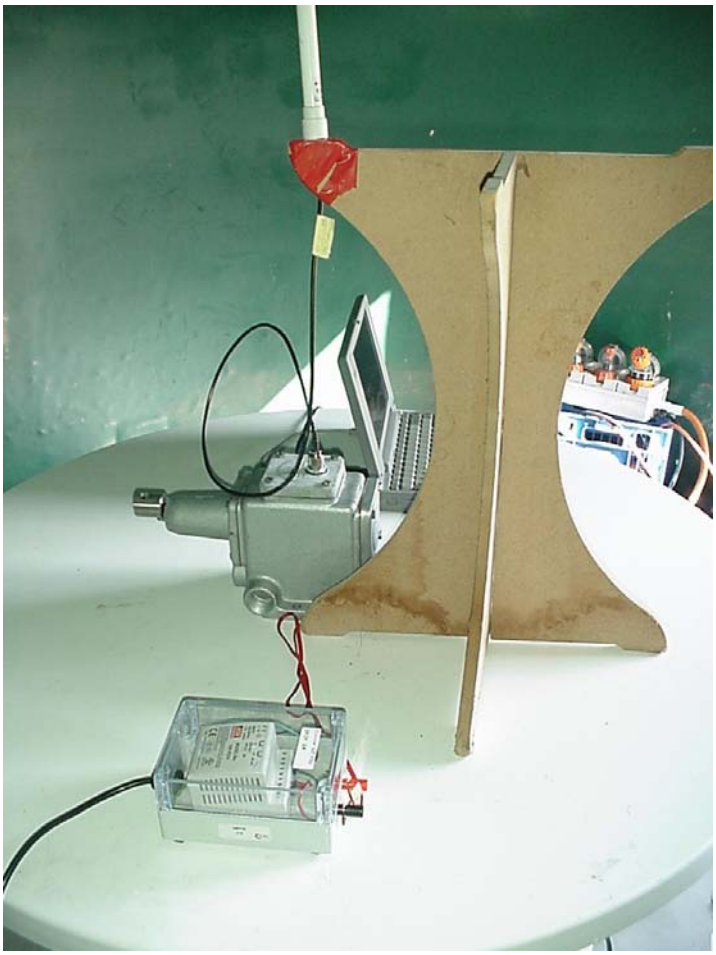
9. PHOTOGRAPHS

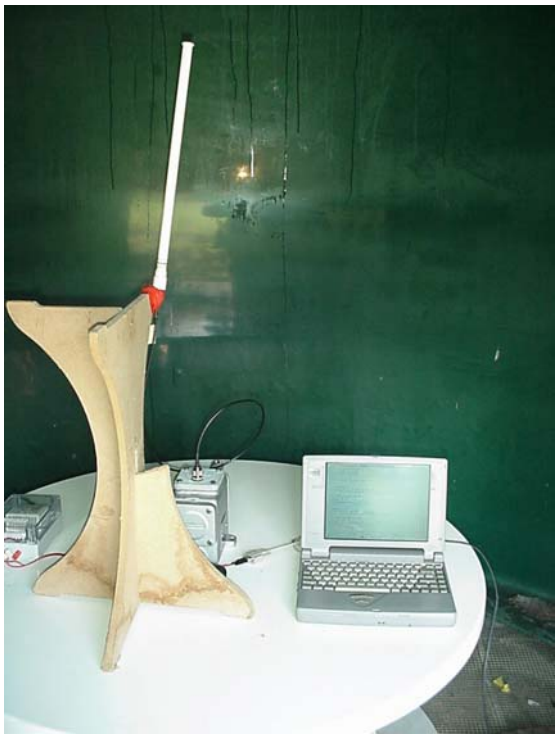
External photos

Outside test set ups: N24-5-NM-B whip antenna directly connected to the device



Outside test set ups: S2406BFNM whip antenna with 1 m length of LMR100 cable attached





Conducted emissions test set up