

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

TEST REPORT

Trio DataCom OM240 Frequency Hopping Spread Spectrum Radio Module

tested for compliance with the

Code of Federal Regulations (CFR) 47

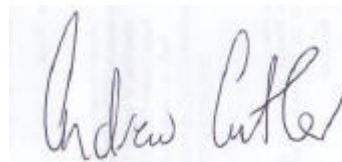
Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators

Section 15.247 – Operation in the band 2400 – 2483.5 MHz

for

Trio DataCom Pty Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager



EMC Technologies (NZ) Ltd

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1. CLIENT INFORMATION

Company Name Trio DataCom Pty Ltd

Address 41 Aster Avenue
Carrum Downs

State Victoria 3201

Country Australia

Contact Mr David Rowntree

2. DESCRIPTION OF TEST SAMPLE

Brand Name Trio DataCom

Range OM240

Product Frequency Hopping Spread Spectrum Radio Module

Manufacturer Trio DataCom Pty Ltd

Country of Origin Australia

Serial Number 300011

FCC ID NI8OM240

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3. RESULT SUMMARY AND COMPLIANCE STATEMENT

The **Trio DataCom OM240 Frequency Hopping Spread Spectrum Radio Module** complies with 47 CFR Part 15.

Testing was carried out in accordance with the test methods defined in 47 CFR Part 15 and in particular Sections, 15.111, 15.205, 15.207, 15.209 and 15.247.

<u>CLAUSE</u>	<u>TEST PERFORMED</u>	<u>RESULT</u>
15.111	Antenna power conduction for receivers	Complies
15.203	Antenna requirement	Not applicable
15.205	Operation in restricted bands	Complies
15.207	Conducted emissions	Complies
15.209	Radiated emissions	Complies
15.247:		
(a)(1)	Hopping channel separation	Complies
(a)(1)(i)	Channel occupancy / bandwidth	Complies
(b)(2)	Peak output power	Complies
(b)(4)	Antenna gain less than 6 dBi	Complies
(d)	Out of band emissions	Complies
(g)	Use of all available channels	Not applicable
(h)	Intelligent frequency hopping	Not applicable
(i)	Radio frequency hazards	Complies

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4. ARTICLES SUBMITTED

The following items were submitted:

- 2400 – 2483.5 MHz frequency hopping spread spectrum transceiver module
- Bluewave BX024XM Omni Direction Antenna. Gain = 12 dBi.
- Bluewave BXY24XM Yagi Antenna. Gain = 12 dBi.
- Bluewave BXL24XM Patch Antenna. Gain = 12 dBi.
- Systron SYSDA Sleeve Dipole Antenna. Gain = 1.5 dBi.

The transmitter module was mounted on the test board which has no external user controls.

In order to test the device the client supplied software that allowed the control of key parameters.

5. TEST SAMPLE DESCRIPTION

The sample tested is a frequency hopping spread spectrum transceiver with the following specifications:

Rated Output Power

6 mW – 500 mW (8 dBm – 27 dBm)

Power can be adjusted from 8 dBm up to 27 dBm in 0.1 dB steps

FCC frequency allocation

2400 – 2483.5 MHz

Operating frequency ranges

2400.590 – 2477.422 MHz

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Test frequencies

2400.590 MHz, 2441.750 MHz, 2477.422 MHz

Number of channels

197

Channel spacing

392 kHz

Hopping sequence

Pseudo random sequence.

Power Supply

This system is not sold with an AC power supply

Conducted measurements have been carried out using a representative 110 Vac to 5 Vdc and 3.3 Vdc power supply.

External Ports and Terminations

- Antenna 1 port. An antenna was attached to this port.
- Antenna 2 port. This port was left unterminated.
- Sys port. A laptop computer was attached to this port using a 20 cm length of data cable.
- Port B serial port. This port was terminated with a 1.2 metre length of data cable and a laptop computer that was not powered.

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6. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The test sample was selected by the client.

The report relates only to the sample tested.

This report does not contain corrections or erasures.

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

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

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7. RESULTS

Section 15.111(a) – Antenna power conduction limits for receivers

In accordance with Section 15.109 (f) receiver power conduction measurements have been made at the antenna terminals.

When the device was in receive mode on a fixed frequency the local oscillator was observed to be approximately 204 MHz below the transmit frequency.

Measurements were made using spectrum analyser operating in peak hold mode.

Channel	Emission (MHz)	Emission level (dBm)	Limit (dBm)
0	2196.630	-73.0	-
	4393.210	-56.8	-
	6589.820	-65.9	
105	2237.780	-75.4	
	4475.510	-53.7	-
	6713.320	-60.9	-
196	2273.770	-80.7	-
	4547.500	-66.6	
	6821.280	-56.8	

Results are provided for information purposes only as this receiver operates above the FCC cut off frequency of 960 MHz.

All other emissions observed above 7 GHz were less than -77.0 dBm.

Result: Complies.

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Section 15.203 – Antenna requirement

This module is to be used inside completed products that will require professional installation to make a completed item.

Antenna port requirement is therefore not applicable as this will be the responsibility of the manufacturer of the final item.

Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.247 (d).

Section 15.207 – Conducted emissions

Measurements have been carried out using a representative power supply.

Conducted emissions testing was carried out over the frequency range of 150 kHz to 30 MHz using a 50 ohms / 50 microhenry artificial mains network.

Testing was carried out at the laboratory's MacKelvie Street screened room.

The device was placed on top of the test table, which is 1m x 1.5m, 80cm above the screened room floor which acts as the horizontal ground plane.

In addition the device was positioned 40cm away from the screened room wall which acts as the vertical ground plane.

The artificial mains network was bonded to the screened room floor.

At all times the device was kept more than 80cm from the artificial mains network.

Quasi peak measurements were made with a receiver bandwidth of 9 kHz with a combined plot being produced showing the results of testing on the phase and neutral AC supply lines.

Measurement uncertainty with a confidence interval of 95% is:

- Mains terminal tests (0.15 - 30 MHz) ± 2.2 dB

Result: Complies with a 0.5 dB margin at 0.330 kHz (Quasi Peak)

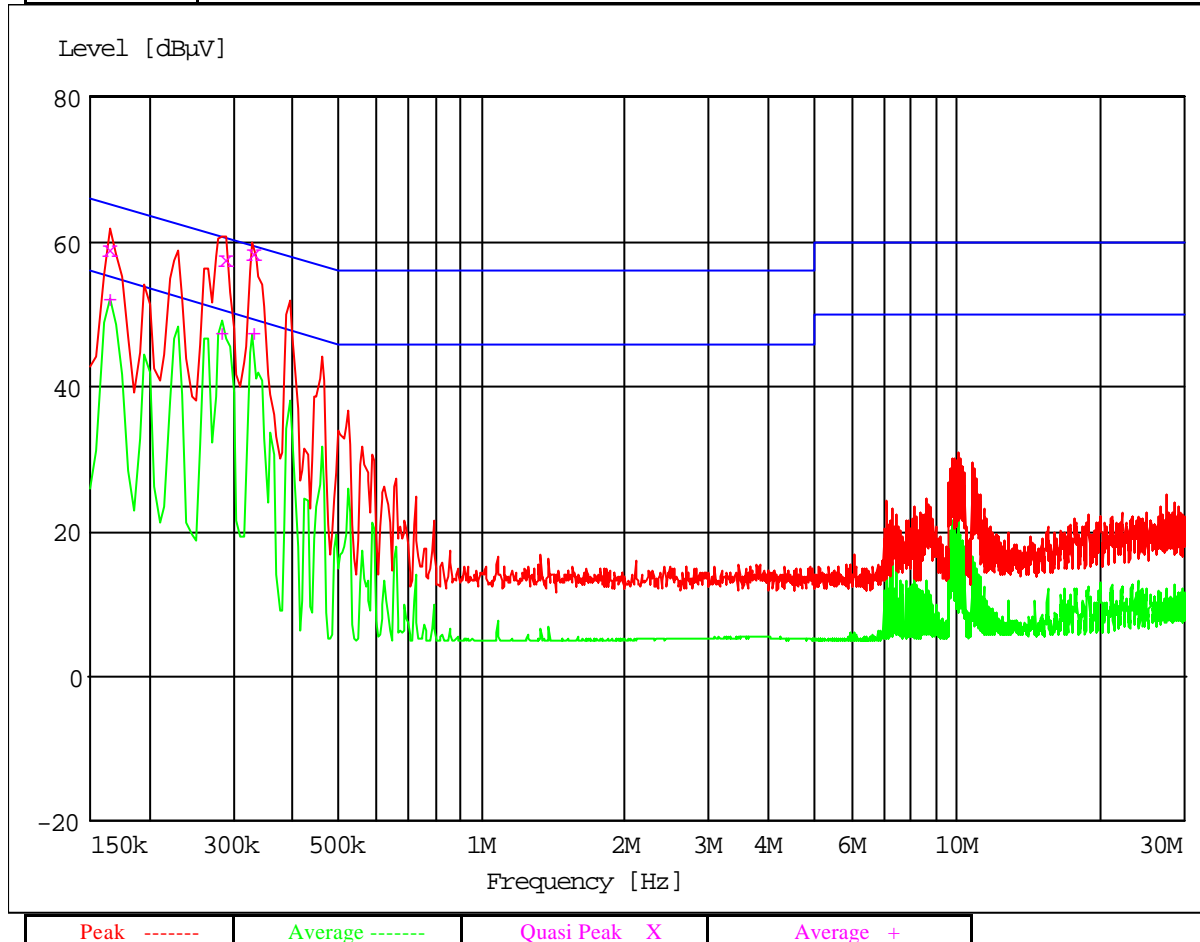
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Conducted Emissions Test

Comments: Device tested when powered at 110 Vac using a representative power supply supplying 3.3 Vdc and 5.0 Vdc to the device. Device was transmitting continuously (hopping) when set to +27 dBm with a dummy load attached



Quasi-Peak Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.165000	59.30	65.2	5.9	L1	57.8
0.290000	58.00	60.5	2.5	L1	
0.330000	58.90	59.4	0.5	L1	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.165000	52.40	55.2	2.8	L1	
0.285000	47.80	50.6	2.8	L1	
0.330000	47.70	49.4	1.7	L1	

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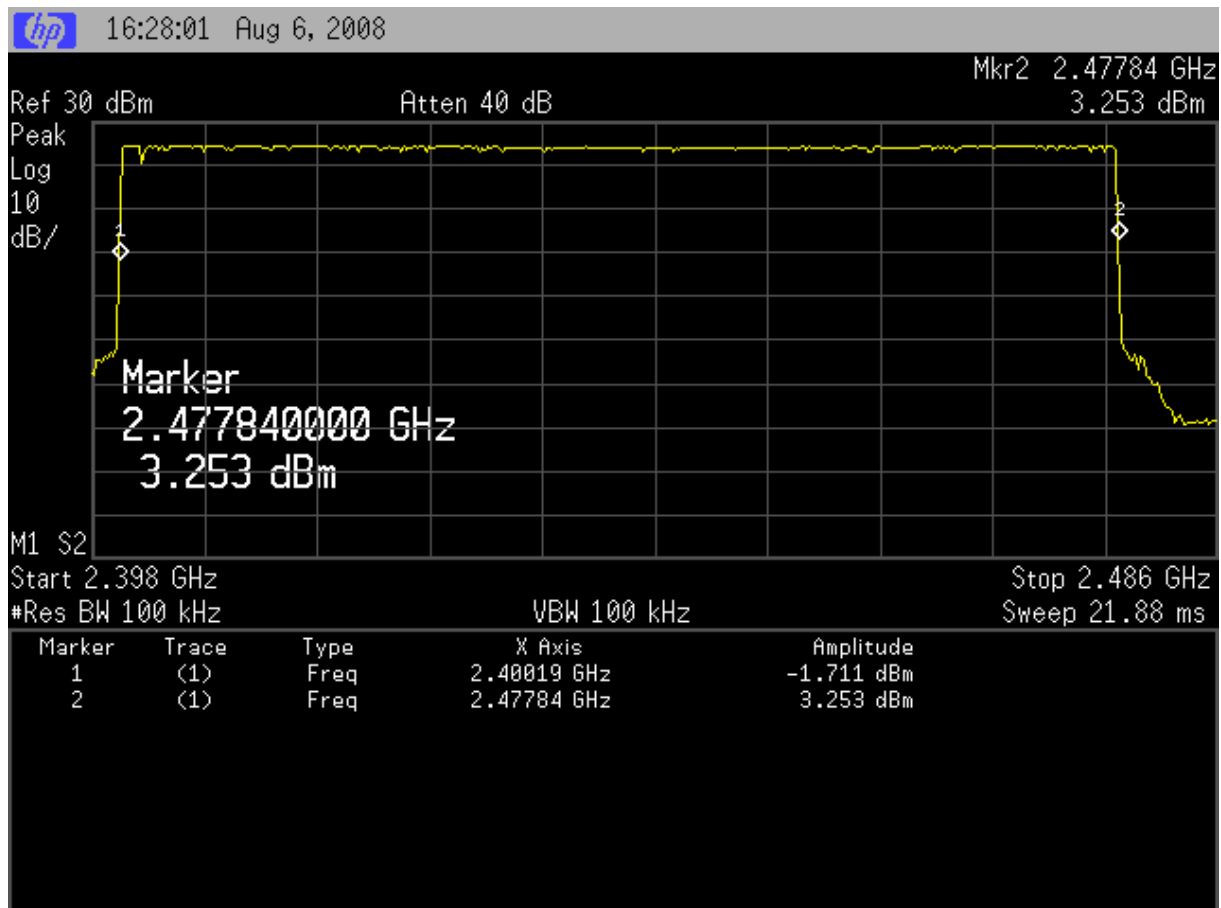
Section 15.209 – Radiated emissions

In accordance with section 15.247(c) attenuation below the general limits specified in Section 15.209(a) except those emissions that fall within the restricted bands defined in Section 15.205(a).

Section 15.247 (a) (1) (i) - Channel occupancy / bandwidth

This device has been configured to operate using 197 channels spaced at 392 kHz.

It can be seen that all channels (0 to 196) between 2400.590 – 2477.422 MHz appear to be in use.

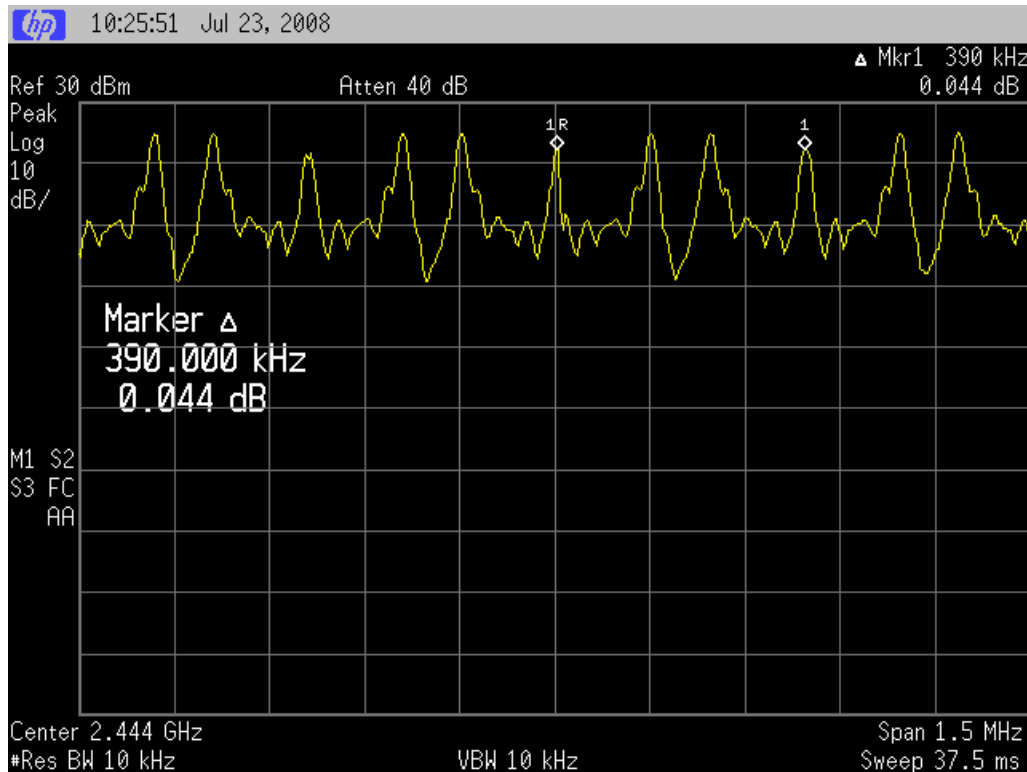


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The client has stated that the channels have a 392 kHz separation which has been measured to be approximately 390 kHz when looking at 3 channels centred on 2443.710 MHz when a data rate of 32 kB/sec was being used.



The device is required to operate with channel frequencies separated by 25 kHz or the 20 dB bandwidth of the hopping channel which ever is greater

Initial measurements of the 20 dB bandwidth were made on channel 0 (2400.590 MHz) to determine the worst case data rate which appears to be at 128 kB/sec when the device was transmitting data.

The results are as follows when 128 kB/sec was used:

Channel	Frequency	20 dB Bandwidth
0	2400.590	380
105	2441.750	375
196	2477.422	380

Plots of these measurements are detailed below.

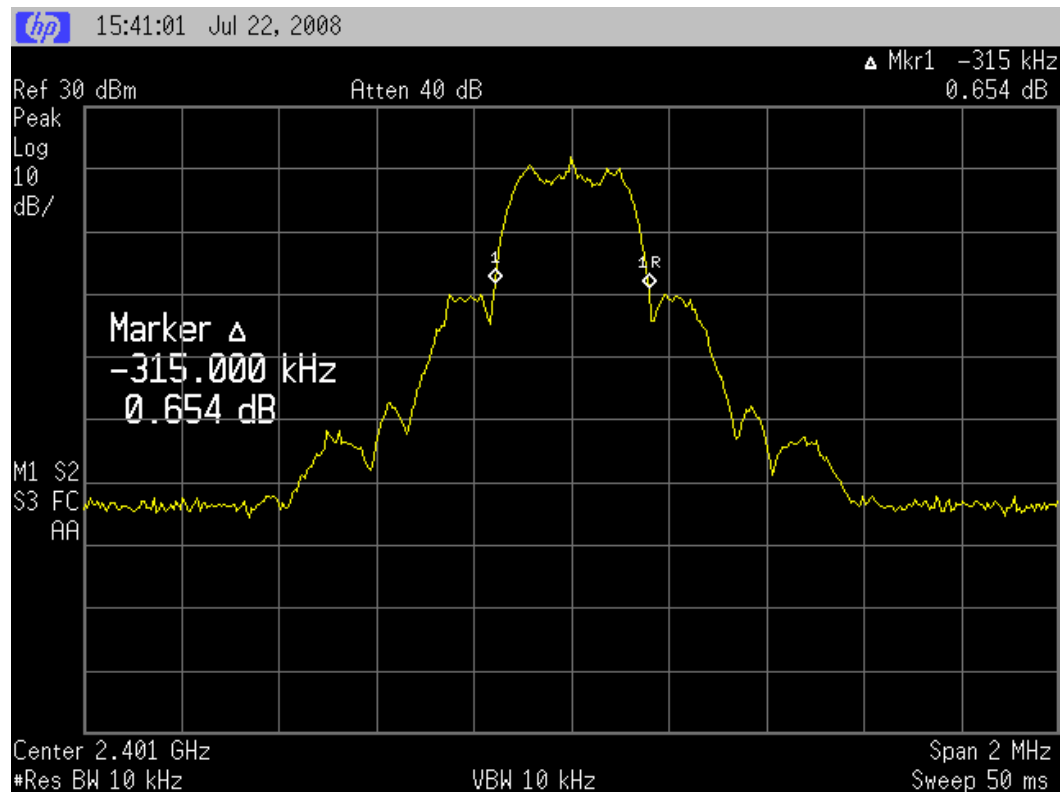
The maximum measured 20 dB bandwidth is less than the measured channel separation of 390 kHz.

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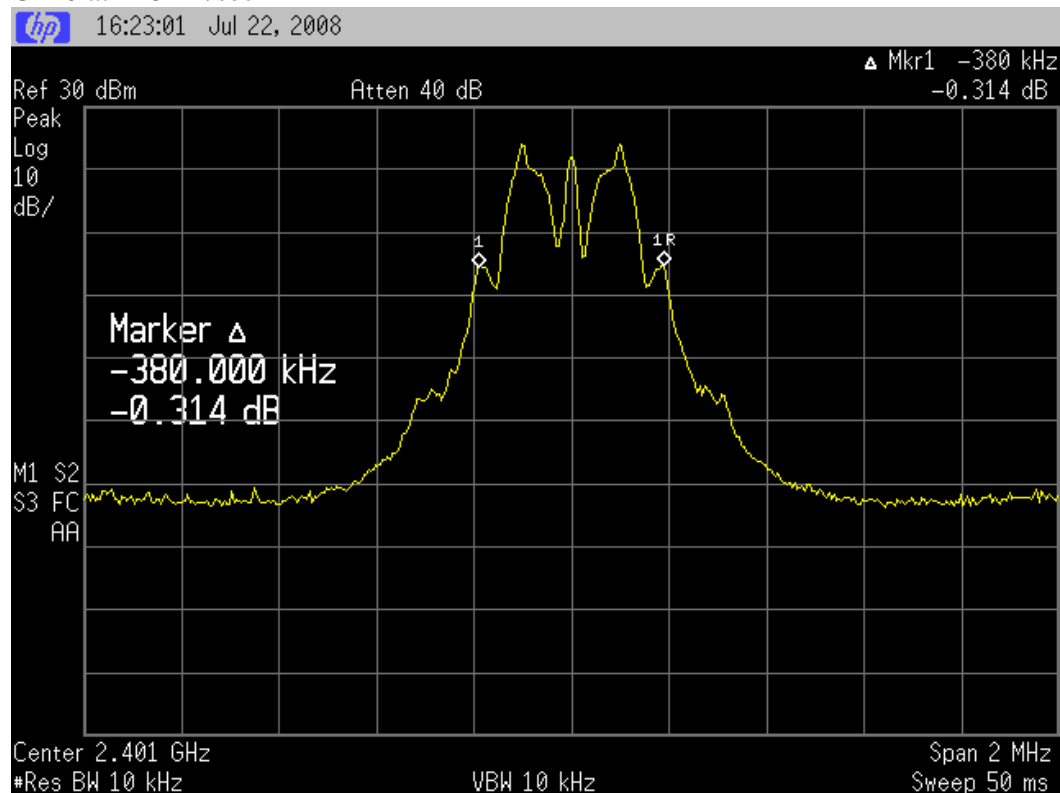
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Chl 0 at 256 kB/sec



Chl 0 at 128 kB/sec



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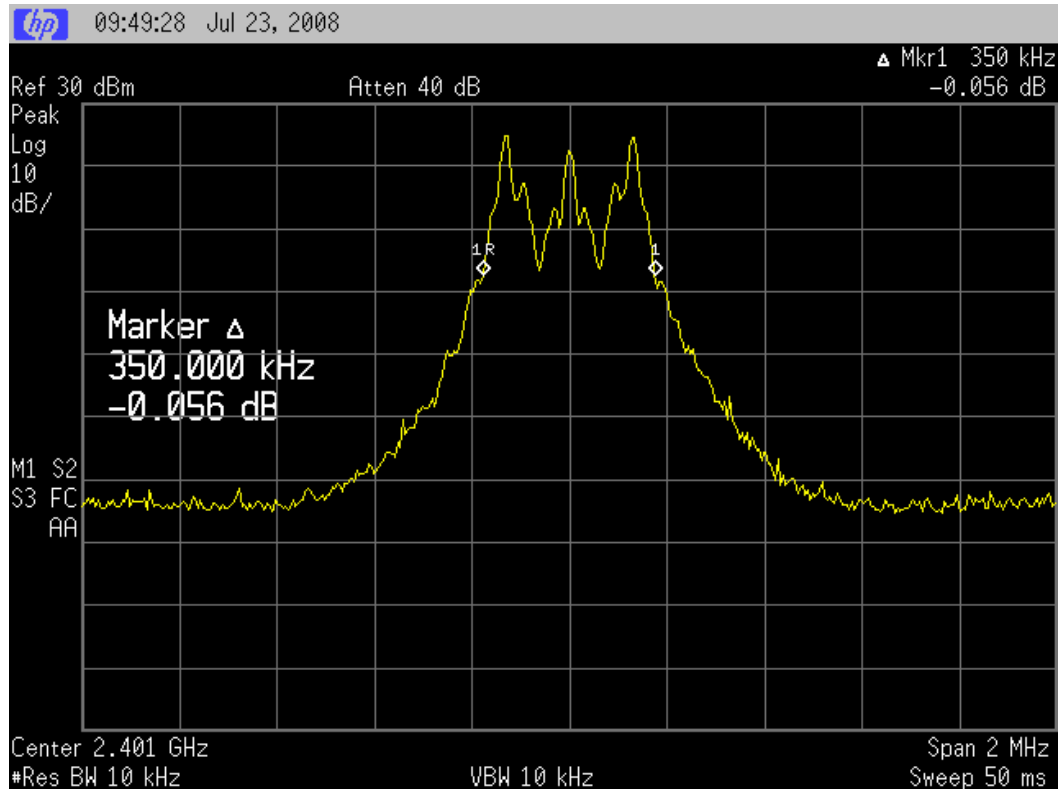
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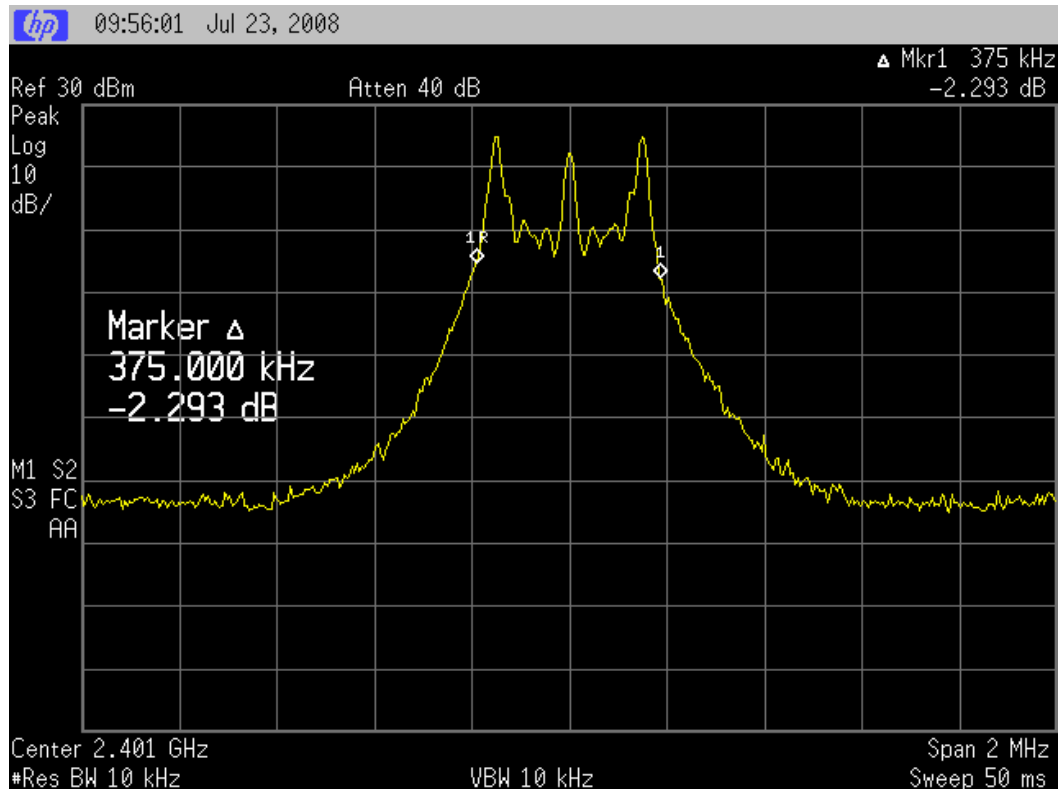
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Channel 0 at 64 kB/sec



Channel 0 at 32 kB/sec



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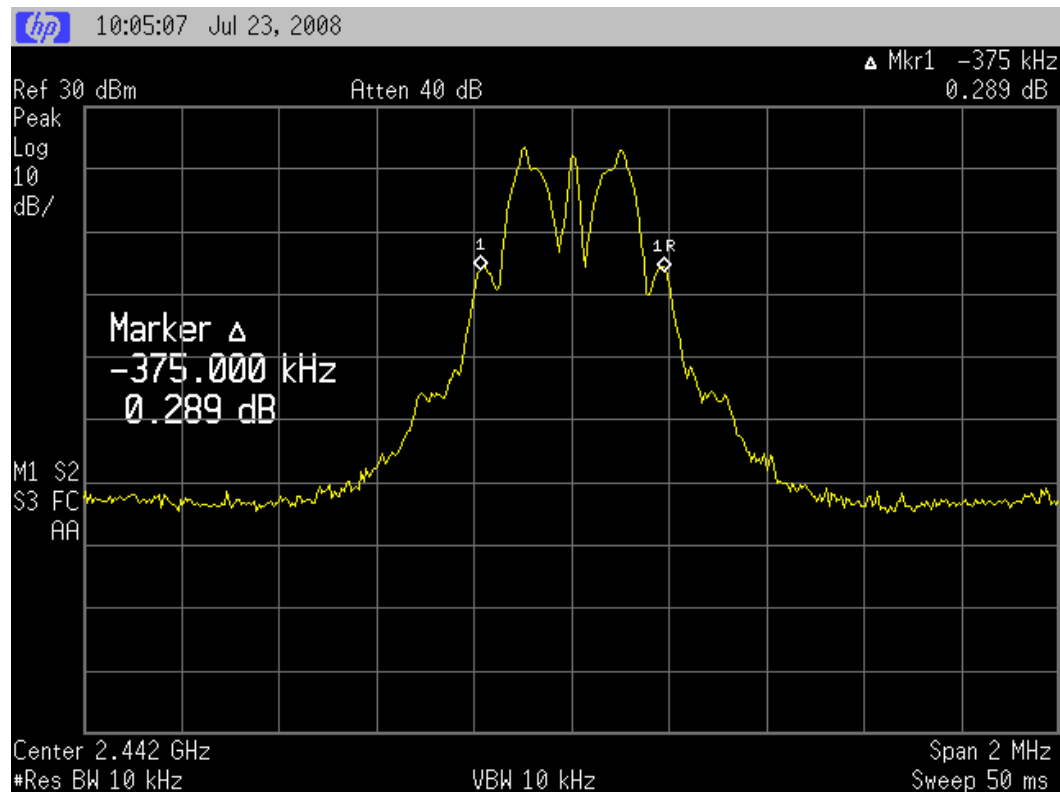
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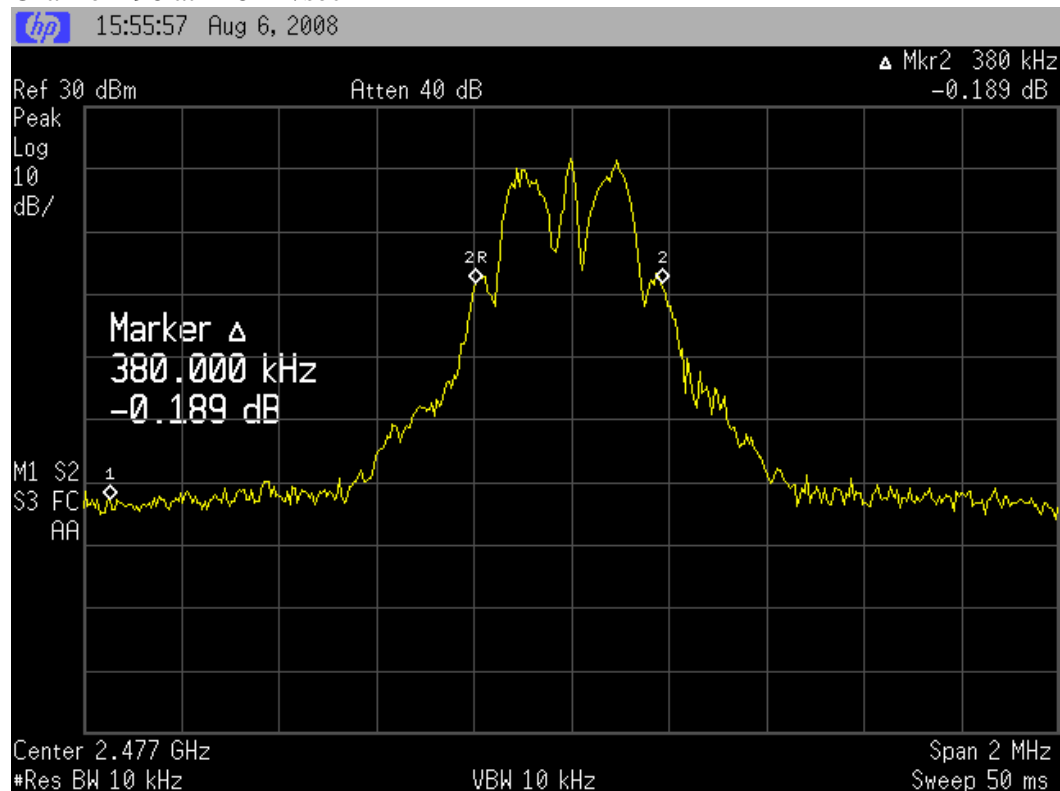
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Channel 105 at 128 kB/sec



Channel 196 at 128 kB/sec



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The average time of occupancy on any channel shall not exceed 400 ms with a period of 400 ms times the number of channels in use.

197 channels are used (channels 0 to 196) time 400 ms = 78.8 seconds

The supplied software allowed the hop interval to be varied between 25 and 250 ms.

All measurements were carried out using a spectrum analyser with a 0 Hz span when tuned to 2441.750 MHz (channel 105) using a data rate of 128 kB/sec which appeared to provide the worst case results for this test.

Hop interval (mS)	Transmissions in 78.8 seconds	Channel Dwell (mS)	Dwell Time (mS)	Limit (mS)
25	17	12.0	204.0	400.0
30	14	21.0	294.0	400.0
50	8	40.0	320.0	400.0
100	4	88.0	352.0	400.0
250	2	126.0	252.0	400.0

Result: Complies

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Section 15.247 (b) (2)– Peak output power

Measurements were carried out at the RF output terminals of the transmitter using a spectrum analyser.

Measurements were carried out using a span of 10 MHz and a resolution bandwidth of 1 MHz while transmitting data at a rate of 128 kB/sec.

Measurements were made using the 110Vac representative power supply where the 110 Vac input voltage was varied between –15% and +15%.

Using the supplied software the output power was measured when set to +27 dBm and +24 dBm in order to determine compliance when different antennas are attached to the device and are used for either general or point to point operations.

Frequency	-15%	Nominal	+15%	Power
2400.590	23.1	23.1	23.1	24.0
2441.750	23.5	23.5	23.5	24.0
2477.422	23.9	23.9	23.9	24.0
2400.590	26.1	26.1	26.1	27.0
2441.750	26.4	26.4	26.4	27.0
2477.422	26.9	26.9	26.9	27.0

The nominal power of this device is from +8 to +27 dBm.

Limits:

The maximum peak output power for frequency hopping systems operating in the 2400 – 2483.5 MHz band using more than 75 channel shall not exceed 1 watt (+30 dBm).

Result: Complies

Measurement Uncertainty: ± 0.5 dB

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Section 15.247 (b)(4) Radiated transmitter power

This transmitter can be used for general use and also for point to point links.

As several of the antennas have gains exceeding 6 dBi, the transmitter output power was reduced by 1 dB from 1 watt (+30 dBm) for every 1 dBi of antenna gain above 6 dBi.

A cable loss of 1 dB was taken into consideration for the cable between the antenna and the transmitter.

12 dBi Patch Antenna:

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.5900	128.1	32.9	36.0	Vertical	3.1	25.0
2400.5900	117.5	22.3	36.0	Horizontal	13.7	25.0
2441.000	127.9	32.7	36.0	Vertical	3.3	25.0
2441.000	118.8	23.6	36.0	Horizontal	12.4	25.0
2477.422	127.4	32.2	36.0	Vertical	3.8	25.0
2477.422	119.5	24.3	36.0	Horizontal	11.7	25.0

12 dBi Yagi Antenna:

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.590	131.1	35.9	36.0	Vertical	0.1	25.0
2441.000	131.2	36.0	36.0	Vertical	0.0	25.0
2477.422	130.1	34.9	36.0	Vertical	1.1	25.0

12 dBi Omni Directional Antenna:

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.590	127.8	32.6	36.0	Vertical	3.4	25.0
2441.000	127.2	32.0	36.0	Vertical	4.0	25.0
2477.422	125.5	30.3	36.0	Vertical	5.7	25.0

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1.5 dBi Sleeve Dipole antenna.

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.590	124.2	29.0	36.0	Vertical	7.0	27.0
2400.590	119.2	24.0	36.0	Horizontal	12.0	27.0
2441.000	124.1	28.9	36.0	Vertical	7.1	27.0
2477.422	124.0	28.8	36.0	Vertical	7.2	27.0

As several of the point to point link antennas have gains exceeding 6 dBi, the transmitter output power was reduced by 1 dB from 1 watt (+30 dBm) or every 3 dBi of antenna gain above 6 dBi.

Assuming an antenna gain of 12 dBi the transmitter power would be reduced to +28.0 dBm.

This would give a directional eirp limit of 40 dBm

In this instance the transmitter maximum output power is +27 dBm and a cable loss of 1 dB was taken into consideration for the cable between the antenna and the transmitter.

12 dBi Patch Antenna:

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.590	130.1	34.9	40.0	Vertical	5.1	27.0
2441.000	130.0	34.8	40.0	Vertical	5.2	27.0
2477.422	130.0	34.8	40.0	Vertical	5.2	27.0

12 dBi Yagi Antenna:

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)	Tx Power (dBm)
2400.590	134.6	39.4	40.0	Vertical	0.6	27.0
2441.000	134.2	39.0	40.0	Vertical	1.0	27.0
2477.422	132.2	37.0	40.0	Vertical	3.0	27.0

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Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out using a resolution bandwidth of 1 MHz while the device was being modulated at a rate of 256 kB/sec while transmitting data.

Result: Complies

Measurement Uncertainty: $\pm 4.1\text{dB}$

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Section 15.247 (b) (5) – 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).

In accordance with this section, and also Section 2.1091, this device has been defined as a mobile device whereby a distance of 20 cm can normally be maintained between the user and the device.

In accordance with Section 1.1310 the Maximum Permissible Exposure (MPE) limits for the General Population / Uncontrolled Exposure of 1.0 mW/cm² have 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:

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

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

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

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

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

The worst case set up will be in point to point mode where use is made of an antenna with a gain of 12 dBi (G=16) and a transmitter output power of +27 dBm (P=0.5 watts) and no cable losses.

Therefore:

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

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

$$d = \sqrt{30 * 0.5 * 16} / 61.4$$

$$d = \underline{0.252 \text{ m or } 25.2 \text{ cm}}$$

This device will comply providing a safe distance of at least 25.2 cm is specified.

Result: Complies

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Section 15.247 (c) – Out of band emissions

Measurements were made at the antenna port with a resolution bandwidth of 100 kHz.

Frequency: 2400.590 MHz (Channel 0)

Frequency (MHz)	Level (dBm)	Limit (dBm)
4801.180	-47.4	+7.0
7201.770	-61.0	+7.0
9602.360	-50.0	+7.0
12002.950	-62.8	+7.0
14403.540	Less than -66	+7.0
16804.130	Less than -66	+7.0
19204.720	Less than -66	+7.0
21605.310	Less than -66	+7.0
24005.900	Less than -66	+7.0

Frequency: 2441.750 MHz (Channel 105)

Frequency (MHz)	Level (dBm)	Limit (dBm)
4883.500	-44.2	+7.0
7325.250	-53.3	+7.0
9767.000	-54.1	+7.0
12208.750	-62.2	+7.0
14650.500	Less than -66	+7.0
17092.250	Less than -66	+7.0
19534.000	Less than -66	+7.0
21975.750	Less than -66	+7.0
24417.500	Less than -66	+7.0

Frequency: 2477.422 MHz (Channel 196)

Frequency (MHz)	Level (dBm)	Limit (dBm)
4954.840	-47.3	+7.0
7432.260	-53.5	+7.0
9909.680	-58.0	+7.0
12387.100	-60.5	+7.0
14864.520	-64.5	+7.0
17341.940	-66.2	+7.0
19819.360	-62.7	+7.0
22296.780	Less than -66	+7.0
24774.200	Less than -66	+7.0

Other emissions observed with a margin to the limit greater than 20 dB have not been recorded.

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Limit:

In any 100 kHz bandwidth outside the frequency band of operation, the RF power produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

Result: Complies

Measurement Uncertainty: ± 3.3 dB

Band edge measurements:

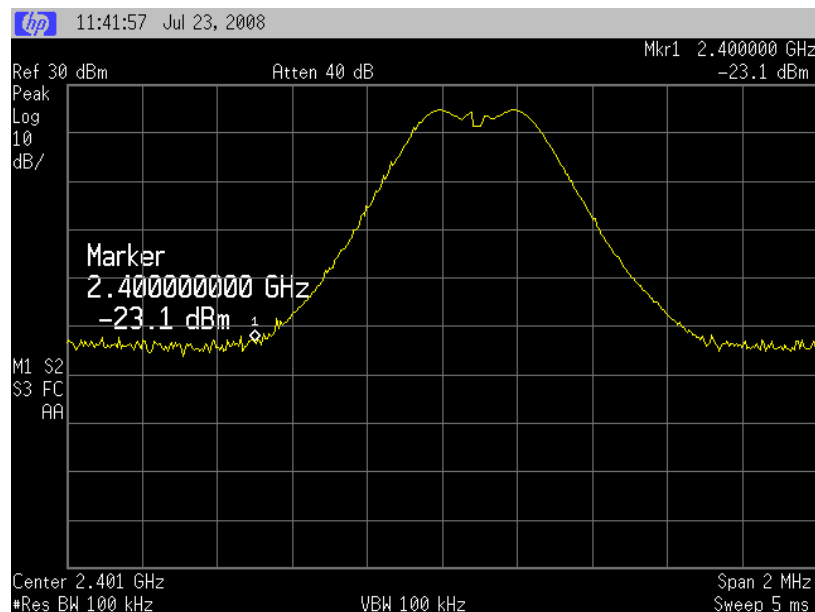
At the band edges of 2400 MHz and 2483.5 MHz all emissions are required to be attenuated by more than 20 dB relative to the highest emission level observed in the band of operation.

The highest rated power of this device is +27 dBm with highest measurement being +26.9 dBm which is approximately +27 dBm.

Therefore at the band edge all levels will need to be less than +7 dBm when measured with a 100 kHz resolution bandwidth.

Results

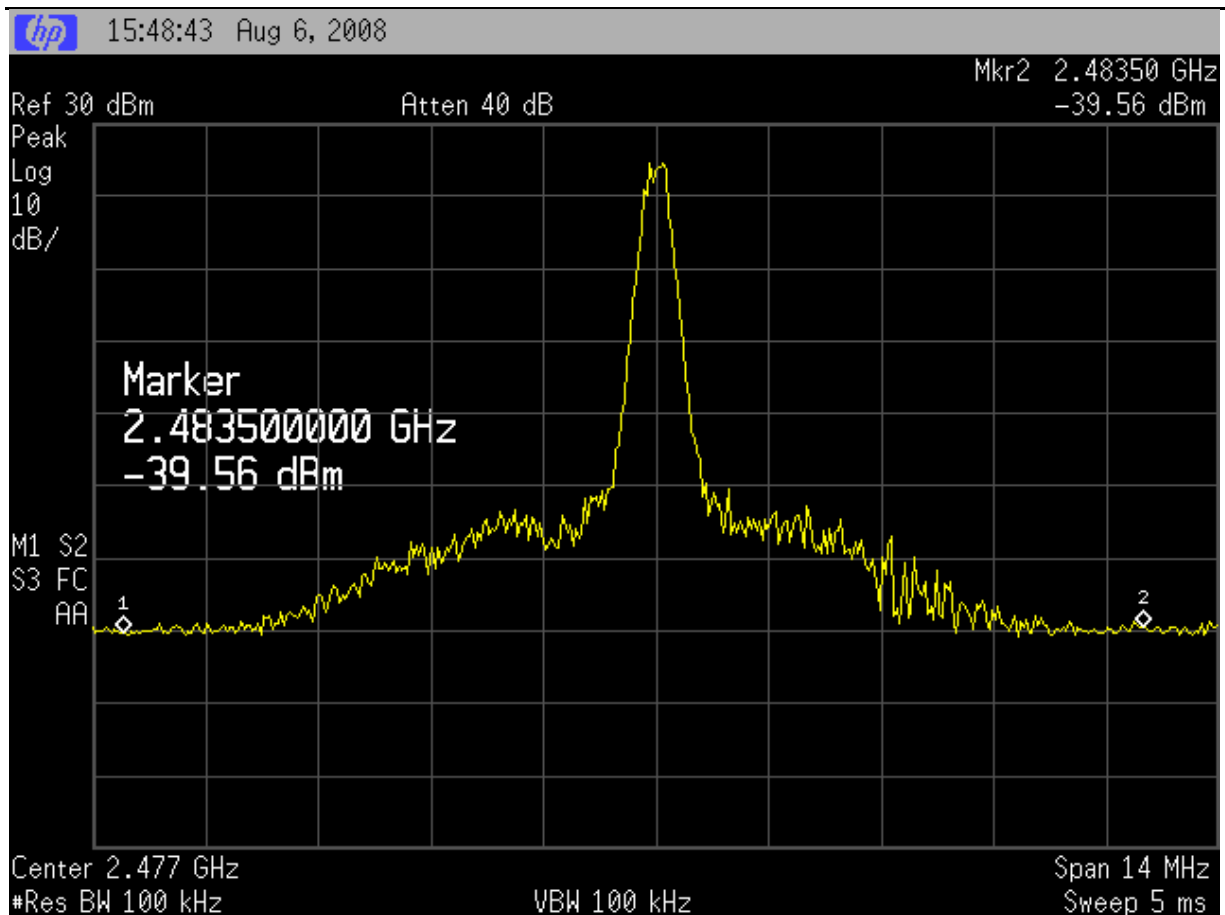
Frequency (MHz)	Level (dBm)	Limit (dBm)
2400.000	-23.1	+7.0
2483.500	-39.6	+7.0



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In addition when an emission falls into a restricted band the general radiated emission limits are to be applied.

At the test site 3 metre measurements were made when the transmitter was transmitting continuously on channel 0 and channel 196 with a transmitter power of +24 dBm and +27 dBm when the various antennas were used.

A restricted band is applied at the 2483.5 MHz band edge extending from 2483.5 MHz to 2500 MHz.

A check was also made of the 2310 – 2390 MHz restricted band.

An average and peak detector were used with resolution bandwidths of 1 MHz.

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The following radiated measurements were made:

Sleeve dipole antenna with the transmitter set to +27 dBi

Channel	Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Detector
0	2390.000	50.2	74.0	Vert	Peak
0	2385.000	52.4	74.0	Vert	Peak
0	2390.000	35.8	54.0	Vert	Average
0	2385.000	37.5	54.0	Vert	Average
196	2483.500	48.1	74.0	Vert	Peak
196	2494.500	48.1	74.0	Vert	Peak
196	2483.500	34.7	54.0	Vert	Average
196	2494.500	35.0	54.0	Vert	Average

Yagi antenna with the transmitter set to +27 dBi

Channel	Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Detector
0	2390.000	47.1	74.0	Vert	Peak
0	2385.000	34.8	74.0	Vert	Peak
0	2390.000	34.2	54.0	Vert	Average
0	2385.000	34.9	54.0	Vert	Average
196	2483.500	50.2	74.0	Vert	Peak
196	2494.500	49.2	74.0	Vert	Peak
196	2483.500	36.2	54.0	Vert	Average
196	2494.500	35.9	54.0	Vert	Average

Patch antenna with the transmitter set to +27 dBi

Channel	Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Detector
0	2390.000	50.2	74.0	Vert	Peak
0	2385.000	53.1	74.0	Vert	Peak
0	2390.000	36.0	54.0	Vert	Average
0	2385.000	37.8	54.0	Vert	Average
196	2483.500	52.5	74.0	Vert	Peak
196	2494.500	50.2	74.0	Vert	Peak
196	2483.500	37.5	54.0	Vert	Average
196	2494.500	36.0	54.0	Vert	Average

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

Omni directional antenna with the transmitter set to +25 dBi

Channel	Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Detector
0	2390.000	50.2	74.0	Vert	Peak
0	2385.000	52.4	74.0	Vert	Peak
0	2390.000	35.8	54.0	Vert	Average
0	2385.000	37.5	54.0	Vert	Average
196	2483.500	50.2	74.0	Vert	Peak
196	2494.500	49.2	74.0	Vert	Peak
196	2483.500	36.2	54.0	Vert	Average
196	2494.500	35.9	54.0	Vert	Average

Result: Complies in the restricted bands at the band edges.

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

Radiated emission measurements

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. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated in Jan 2007..

The device 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 with the antenna located at a 3 m horizontal distance from the boundary of the device under test.

Measurements below 1000 MHz were made using an 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. The emission is measured in both vertical and horizontal antenna polarisations.

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

$$\text{Level (dB}\mu\text{V/m)} = \text{Receiver Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB)} + \text{Coax Loss (dB)}$$

EMC Technologies (NZ) Ltd

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General emissions observed when the device was transmitting.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Antenna Polarity
31.950	23.4		97.8	74.4	Vertical
40.000	20.5		97.8	77.3	Vertical
42.500	25.2		97.8	72.6	Vertical
80.000	35.0	38.8	97.8	59.0	Horizontal
106.995	28.3		97.8	69.5	Vertical
120.000	23.1		43.5	20.4	Vertical
160.000	23.7	26.1	97.8	71.7	Horizontal
200.000		31.4	97.8	66.4	Horizontal
240.000	27.0	37.3	46.0	8.7	Horizontal
280.000	34.0	42.3	46.0	3.7	Horizontal
320.000	35.2	45.2	97.8	52.6	Horizontal
360.000	32.9	44.5	97.8	53.3	Horizontal
400.000	34.2	43.6	46.0	2.4	Horizontal
412.863		35.0	97.8	62.8	Horizontal
440.000	36.0	42.9	97.8	54.9	Horizontal
480.000	38.6	34.5	97.8	59.2	Vertical
520.000	35.0	33.6	97.8	62.8	Vertical
560.000	39.1	35.9	97.8	58.7	Vertical
600.000	34.0	35.9	97.8	61.9	Horizontal
600.000	34.4	36.1	97.8	61.7	Horizontal
640.000	41.8	38.7	97.8	56.0	Vertical
680.000	36.4	44.3	97.8	53.5	Horizontal
720.000	44.6	48.1	97.8	49.7	Horizontal
800.000	39.6	45.3	97.8	52.5	Horizontal
840.000		41.0	97.8	56.8	Horizontal
880.000		39.7	97.8	58.1	Horizontal
920.000		39.4	97.8	58.4	Horizontal

The lowest emission level observed was 117.8 dBuV/m when the sleeve antenna was used.

This gives a -20 dBc worst case limit of 97.8 dBuV/m which has been applied in the frequency bands that are not restricted.

All other general emissions detected had a margin to the limit exceeding 15 dB when measurements were attempted up to 2.4 GHz using both vertical and horizontal polarisations.

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

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Radiated transmitter spurious emission testing was carried out with the various antennas attached at a distance of 3 metres.

Each antenna was powered at the highest power for the particular antenna with measurements made on Channels 0, 105 and 196 with a data rate of 256 kbits/sec.

In the restricted bands measurements were made with a peak and an average detector with a 1 MHz bandwidth with an average limit of 54 dBuV/m being applied and a peak limit of 74 dBuV/m being applied.

If a peak measurement complies with the average limit an average measurement was not made.

In the non restricted bands measurements were made with a peak detector with a 100 kHz bandwidth with a -20 dBc limit of 97.8 dBuV/m being applied

Measurements were attempted up to 24 GHz.

Initially measurements were attempted at a distance of 3 metres using a pre amplifier however only 2fc and 3fc emissions were observed.

Further measurements were made at distances of 1.0 and 0.3 metres to determine if any of the higher order harmonics could be observed.

Measurements were also attempted at 1.0 and 0.3 metres without the pre amplifier to determine if the lower order harmonics were being observed due to overloading in the pre amplifier.

No emissions were detected above 3fc (7.2 GHz etc) when measurements were attempted with the preamplifier at 3, 1 and 0.3 metres.

Only emissions at 2fc and 3fc were observed which have been recorded as detailed.

Measurements were made in vertical and horizontal polarisations with only the highest level polarisation being recorded.

Result: Complies

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

1.5 dBi Sleeve dipole antenna with the transmitter set to +27 dBm.

Channel 0 – 2400.590 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4801.500	< 53.7	74.0	Vertical	> 20.3	Peak
4801.500	< 45.4	54.0	Vertical	> 8.6	Peak
7202.250	< 59.6	74.0	Vertical	> 14.4	Average
7202.250	< 48.7	54.0	Vertical	> 5.3	Average

Channel 105 – 2441.750 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4883.500	57.4	74.0	Vertical	16.6	Peak
4883.500	46.5	54.0	Vertical	7.5	Peak
7325.250	< 62.1	74.0	Vertical	> 11.9	Average
7325.250	< 49.4	54.0	Vertical	> 4.6	Average

Channel 196 – 2477.422 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4954.800	54.0	74.0	Vertical	20.0	Peak
4954.800	42.8	54.0	Vertical	11.2	Peak
7432.200	< 62.1	74.0	Vertical	> 11.9	Average
7432.200	< 49.4	54.0	Vertical	> 4.6	Average

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

12 dBi Omni directional antenna with the transmitter set to +25 dBm.

Channel 0 – 2400.590 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4801.500	< 53.9	74.0	Vertical	> 20.1	Peak
4801.500	< 37.3	54.0	Vertical	> 16.7	Average
7202.250	< 55.5	74.0	Vertical	> 18.5	Peak
7202.250	< 43.5	54.0	Vertical	> 10.5	Average

Channel 105 – 2441.750 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4883.500	< 51.0	74.0	Vertical	> 23.0	Peak
4883.500	< 36.7	54.0	Vertical	> 17.3	Average
7325.250	< 55.6	74.0	Vertical	> 18.4	Peak
7325.250	< 41.6	54.0	Vertical	> 12.4	Average

Channel 196 – 2477.422 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4954.800	< 50.0	74.0	Vertical	> 24.0	Peak
4954.800	< 39.1	54.0	Vertical	> 14.9	Average
7432.200	< 54.5	74.0	Vertical	> 19.5	Peak
7432.200	< 42.8	54.0	Vertical	> 11.2	Average

EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

12 dBi Yagi antenna with the transmitter set to +27 dBm

Channel 0 – 2400.590 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4801.500	53.9	74.0	Vertical	20.1	Peak
4801.500	37.3	54.0	Vertical	16.7	Average
7202.250	55.5	74.0	Vertical	18.5	Peak
7202.250	43.5	54.0	Vertical	10.5	Average

Channel 105 – 2441.750 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4883.500	51.0	74.0	Vertical	23.0	Peak
4883.500	36.7	54.0	Vertical	17.3	Average
7325.250	55.6	74.0	Vertical	18.4	Peak
7325.250	41.6	54.0	Vertical	12.4	Average

Channel 196 – 2477.422 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4954.800	50.0	74.0	Vertical	24.0	Peak
4954.800	39.1	54.0	Vertical	14.9	Average
7432.200	54.5	74.0	Vertical	19.5	Peak
7432.200	42.8	54.0	Vertical	11.2	Average

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Test Report No **80707.1**

Report date: 20 August 2008

12 dBi Patch antenna with the transmitter set to +27 dBm.

Channel 0 – 2400.590 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4801.500	53.7	74.0	Vertical	20.3	Peak
4801.500	45.4	54.0	Vertical	8.6	Average
7202.250	< 59.6	74.0	Vertical	> 14.4	Peak
7202.250	< 47.6	54.0	Vertical	> 6.4	Average

Channel 105 – 2441.750 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4883.500	53.0	74.0	Vertical	21.0	Peak
4883.500	41.7	54.0	Vertical	12.3	Average
7325.250	< 60.2	74.0	Vertical	> 13.8	Peak
7325.250	< 48.2	54.0	Vertical	> 5.8	Average

Channel 196 – 2477.422 MHz

Frequency MHz	Level dBuV/m	Limit dBuV/m	Antenna Polarity	Margin dB	Detector
4954.800	54.0	74.0	Vertical	20.0	Peak
4954.800	42.8	54.0	Vertical	11.2	Average
7432.200	< 60.6	74.0	Vertical	> 13.4	Peak
7432.200	< 48.6	54.0	Vertical	> 5.4	Average

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8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applicable
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	Not applicable
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applicable
Receiver	R & S	ESHS 10	828404/005	3728	21 Aug 2009
Mains Network	R & S	ESH2-Z5	881362/032	3628	21 Aug 2009
Receiver	R & S	ESCS 30	847124/020	E1595	21 Feb 2009
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3771	20 April 2009
Microwave Preamplifier	Hewlett Packard	8349B	2644A01659	-	20 April 2009
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2009
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2009
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2009
Horn Antenna	Electrometrics	RGA-60	6234	E1492	10 May 2009
Horn Antenna	EMCO	3116	2276	-	10 May 2009

9. ACCREDITATIONS

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated in January 2007.

The tests were carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025: 2005.

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

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10. PHOTOGRAPH (S)

Label

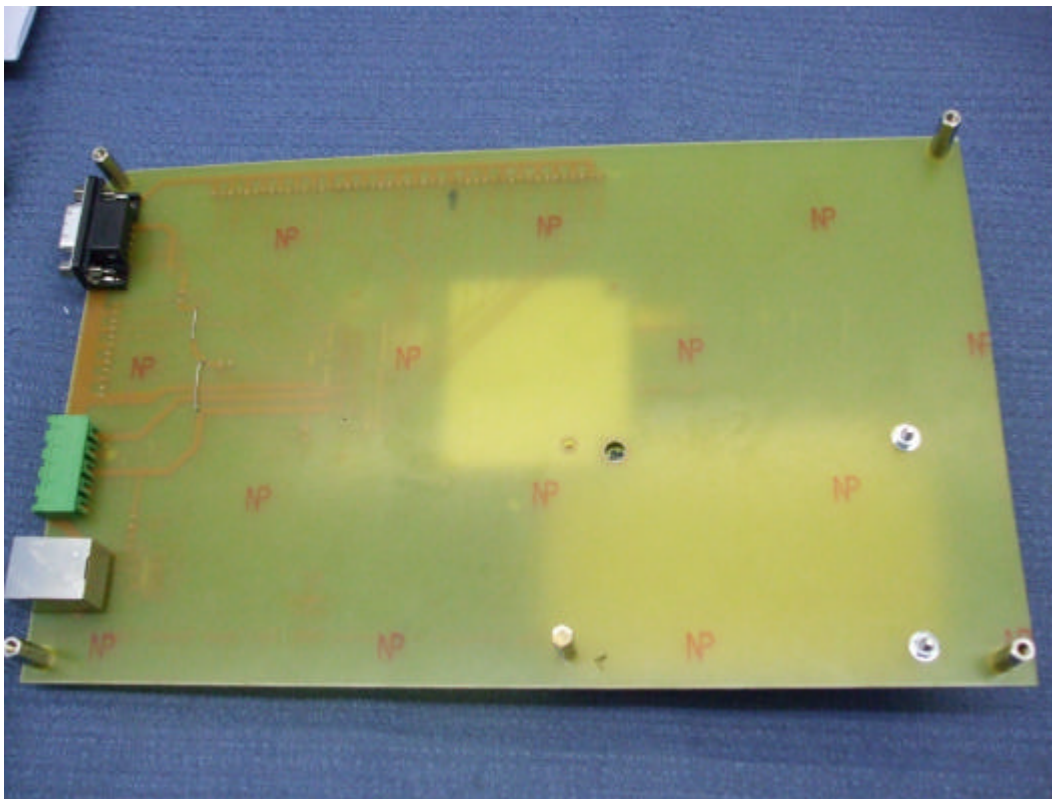
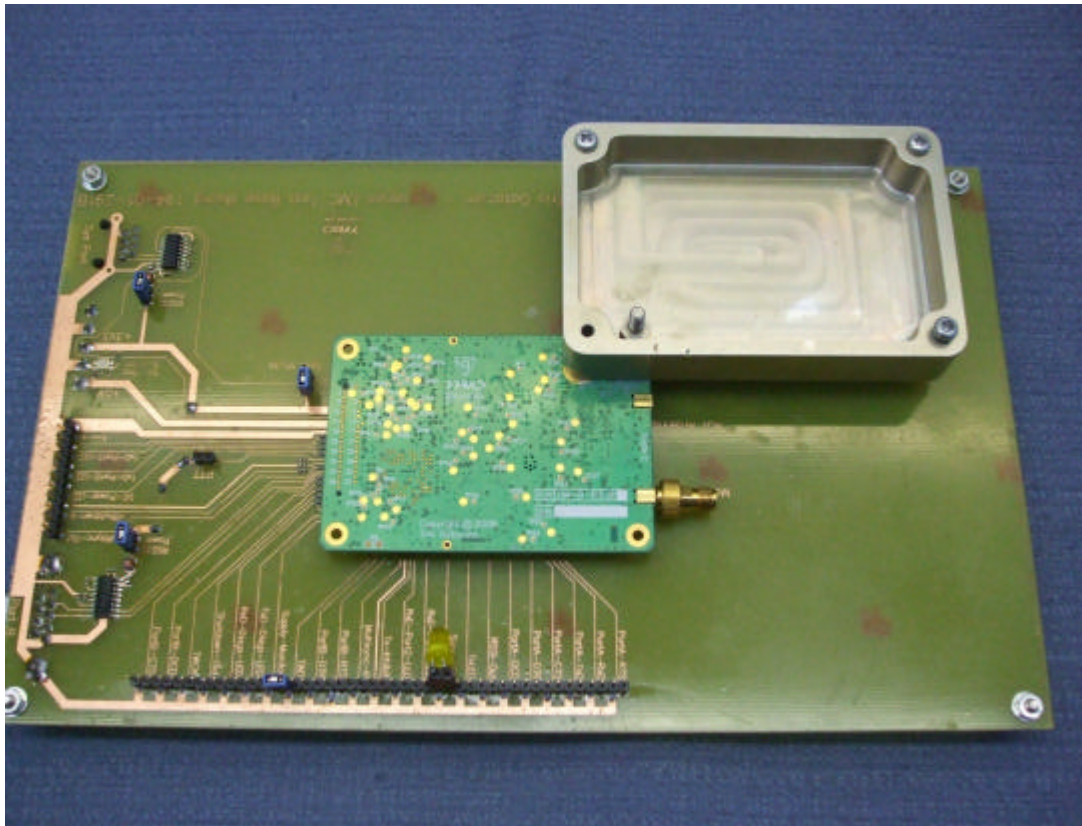


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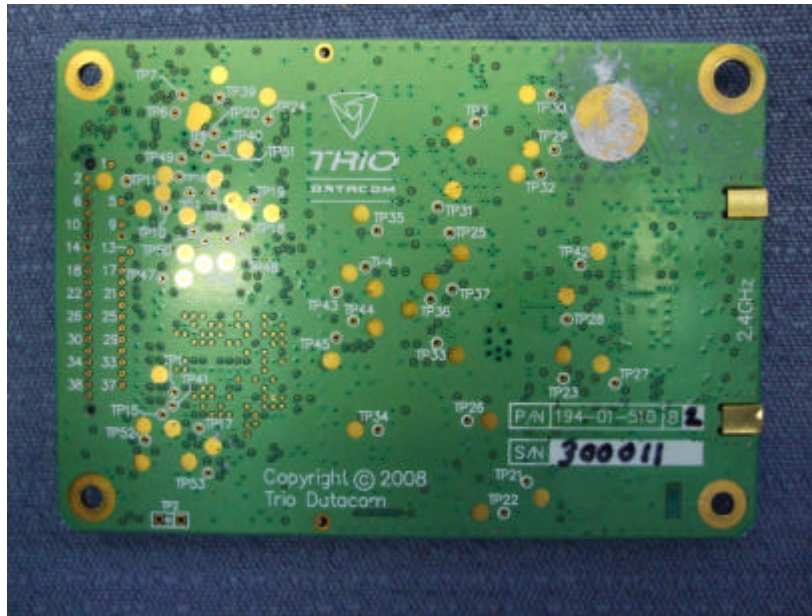
External / Internal views



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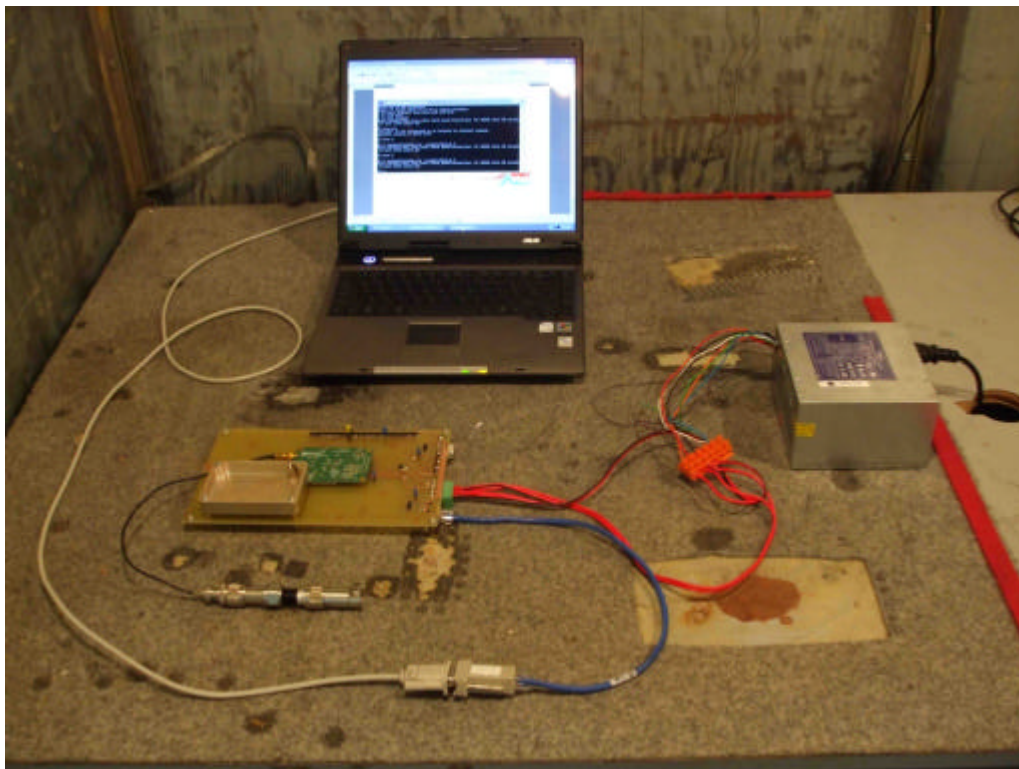
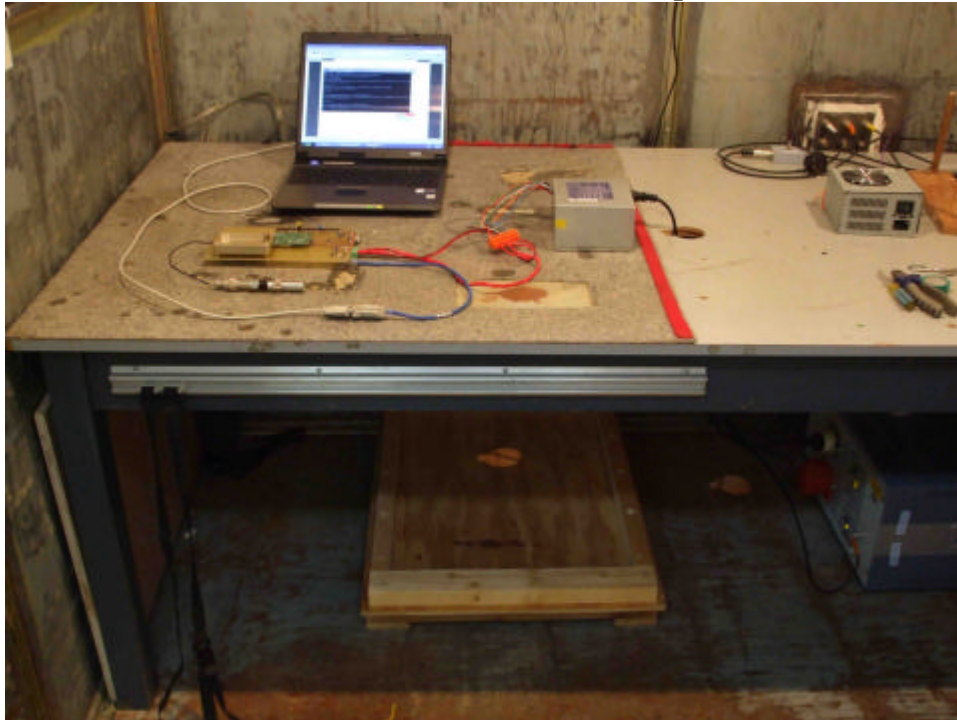


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Conducted emissions test set up:

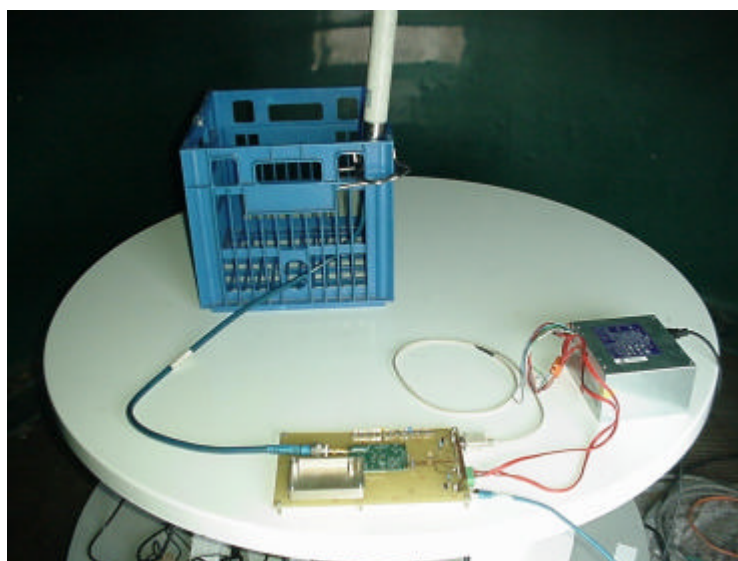
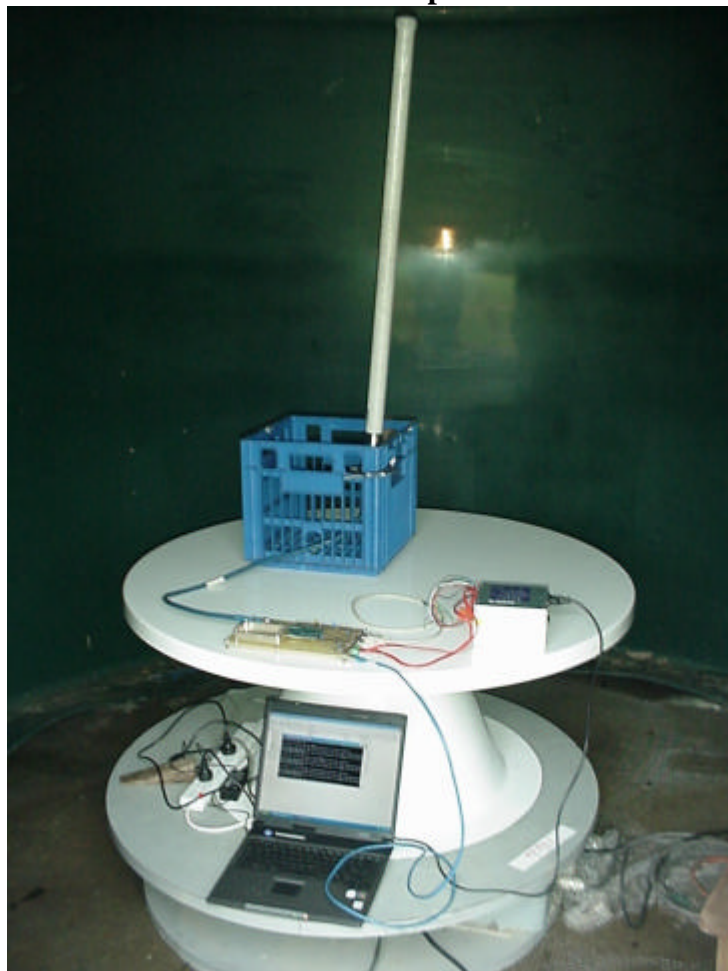


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Radiated emissions test set up – 12 dBi Omni Antenna

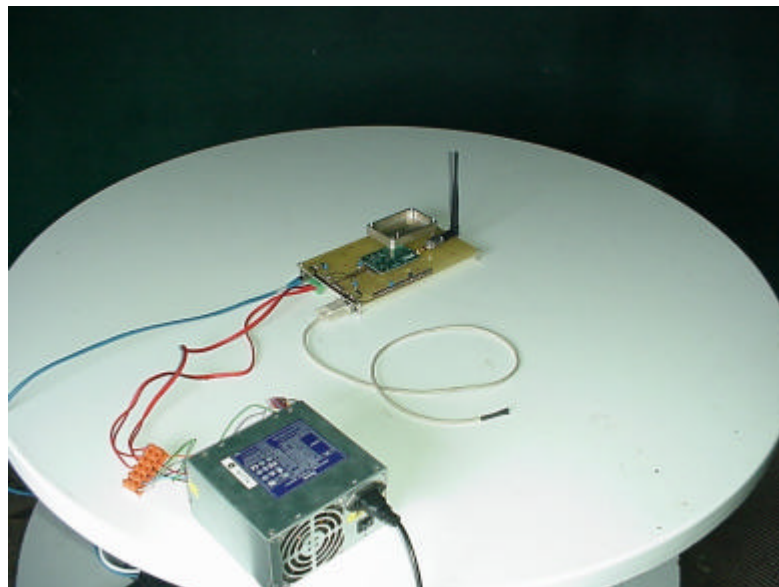
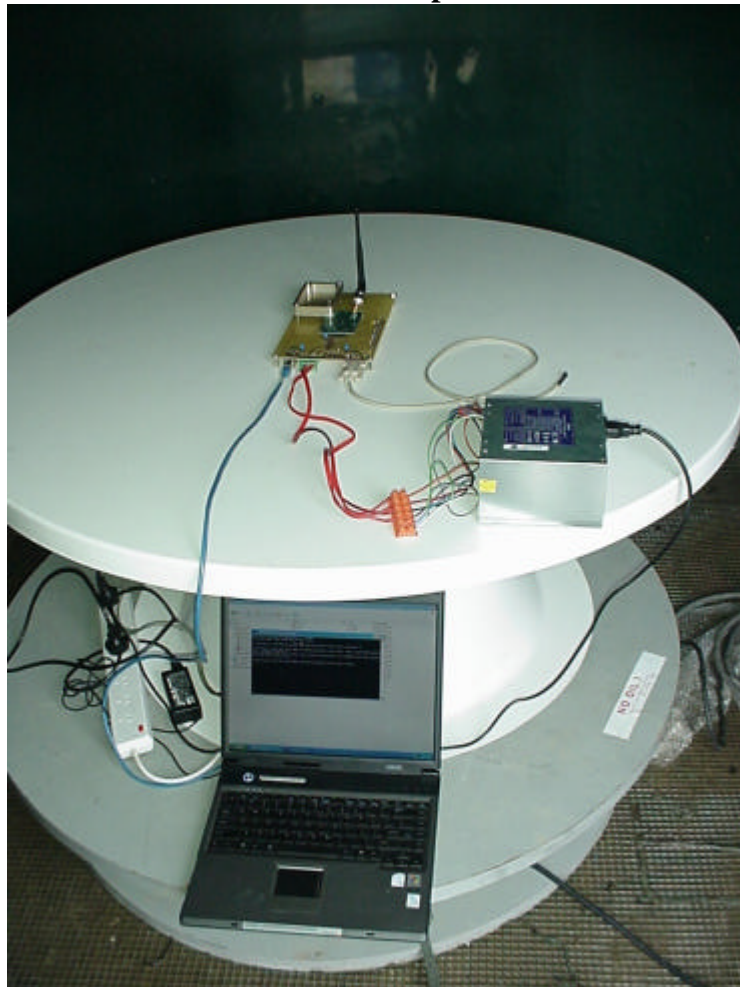


EMC Technologies (NZ) Ltd

Test Report No **80707.1**

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1.5 dBi Sleeve whip antenna

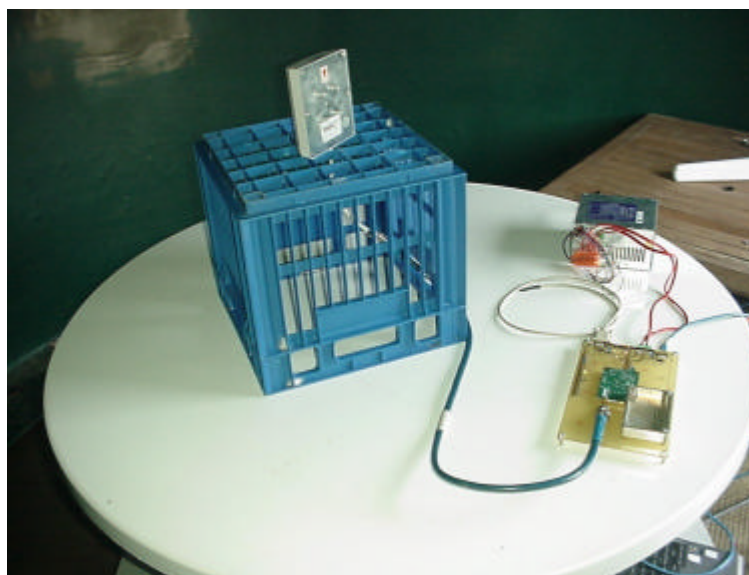
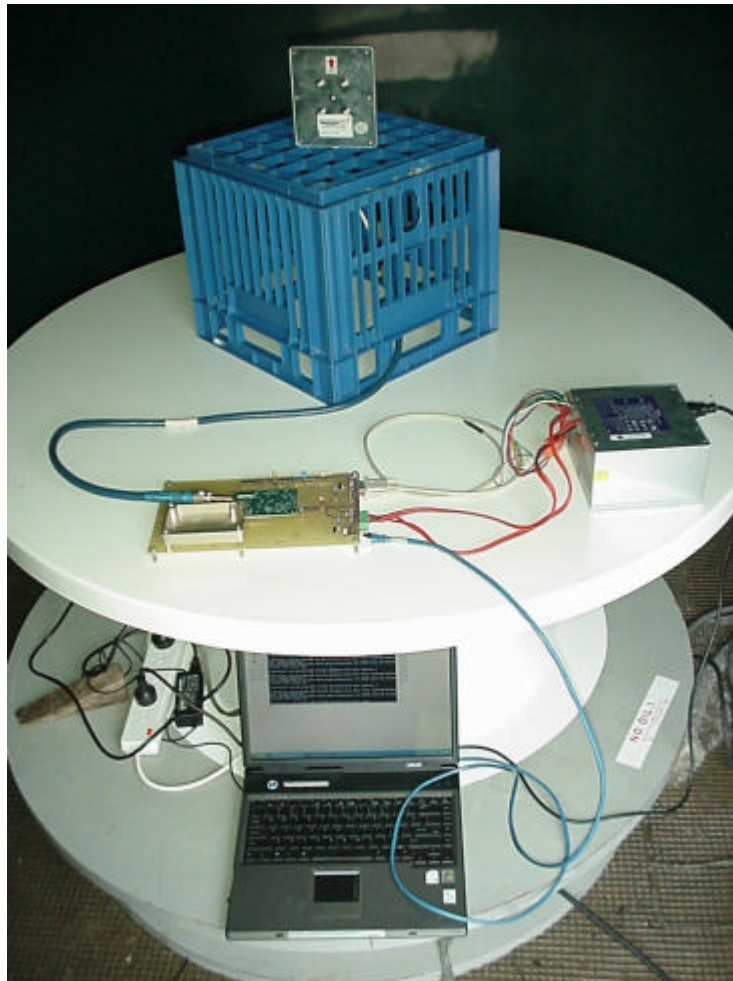


EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

12 dBi Patch antenna



EMC Technologies (NZ) Ltd

Test Report No **80707.1**

Report date: 20 August 2008

12 dBi Yagi antenna

