

EMC Technologies (NZ) Ltd

Test Report No 20101 FCC
Report date: 31 January 2002

TEST REPORT

RFI 9256TRX Data Strike Series 3 900 MHz Spread Spectrum Radio

tested for compliance with the

Code of Federal Regulations (CFR) 47

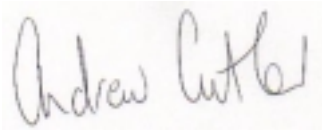
Part 15 – Radio Frequency Devices, Subpart C – Intentional Radiators

Section 15.247 – Operation in the band 902 – 928 MHz

for

RF Innovations Pty Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

Report prepared by:



Karen Miller – Office Administrator



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1. CLIENT INFORMATION

Company Name	RF Innovations Pty Ltd
Address	22 Boulder Road
State	Western Australia 6090
Country	Australia
Contact	Mr Carlos M Tomaz

2. DESCRIPTION OF TEST SAMPLE

Brand Name	RFI
Model Number	9256 TRX
Product Name	Data Strike Series 3
Product	900 MHz Spread Spectrum Radio
Manufacturer	RF Innovations Pty Ltd
Country of Origin	Australia
Serial Number	007093CF1421
FCC ID	P5M9256TRX

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3. SUMMARY OF TEST RESULTS

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	Complies
15.205	Operation in restricted bands	Complies
15.207	Conducted emissions	Complies
15.209	Radiated emissions	Complies
15.247:		
(a)(1)(i)	Channel occupancy / bandwidth	Complies
(b)(2)	Peak output power	Complies
(b)(4)	Radio frequency hazard	Complies
(c)	Out of band emissions	Complies

4. ARTICLES SUBMITTED

The following items were submitted:

- 902 – 928 MHz frequency hopping spread spectrum transceiver
- Whip antenna
- Length of coax cable

The transmitter has no external user controls.

Testing was carried out using software that allowed the following changes:

- Frequency hopping in two bands: 902 – 915 MHz and 915 – 928 MHz.
- Frequency hopping over the whole band 902 – 928 MHz
- Operation on 902 and 927 MHz only
- Single frequency operation.

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5. TEST SAMPLE DESCRIPTION

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

Rated Transmitter Output Power

1 watt

Test frequencies

902 – 928 MHz

51 frequencies in a pseudo random sequence with a frequency spacing of 500 kHz

Power Supply

This system is sold without an AC power supply with only a DC supply input provided.

Provision of a power supply will be the responsibility of the purchaser.

Conducted measurements have been carried out using a laboratory supplied representative 110 Vac / 12 Vdc power supply.

External Ports

The Radio Telemetry Module has the following ports:

- antenna port (unique connector)
- RS 232 port

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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:

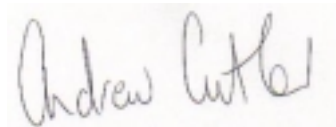
The test sample was selected by the client.

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. TESTING 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.

Device operated in receive only mode. This was achieved by operating the device as a Slave.

Receive Frequency: 911.500 MHz

Measured Spurious Emission		
Emission (MHz)	Emission level (dBm)	Limit (dBm)
214.000	-76.5	-57.0
428.000	-80.0	-57.0
1498.030	-77.1	-57.0
2354.000	-77.9	-57.0
686.800	-64.7	-57.0
1159.600	-68.4	-57.0
1373.600	-60.7	-57.0
2072.420	-81.4	-57.0
4120.800	-71.5	-57.0
6181.200	-78.8	-57.0

First IF = 224.700 MHz.

Second IF = 10.7 MHz

In accordance with Section 15.31(o) only levels within 20 dB of the limit have been reported.

In the range 30 – 5000 MHz the power at the antenna terminal shall not exceed 2 nW (-57 dBm).

Result: Complies.

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Section 15.203 – Antenna requirement

The antenna to be used with this system is a RF Industries Pty Ltd CD1625 Series GSM antenna.

This antenna is attached to the system using a unique connector.

The connector looks like a standard BNC connector however it is not and needs to be milled to the appropriate standard.

A photograph of this unique connector is contained within this report.

Section 15.205 – Restricted bands of operation

Refer to measurements made with reference to Section 15.247 (c)

Section 15.207 – Conducted emissions

This system is sold without an AC power supply. Provision of a power supply will be the responsibility of the purchaser.

Measurements have been carried out using a representative 110 Vac / 12 Vdc power supply.

Conducted emissions testing was carried out over the frequency range of 450 kHz to 30 MHz.

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.

Measurement uncertainty with a confidence interval of 95% is:

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

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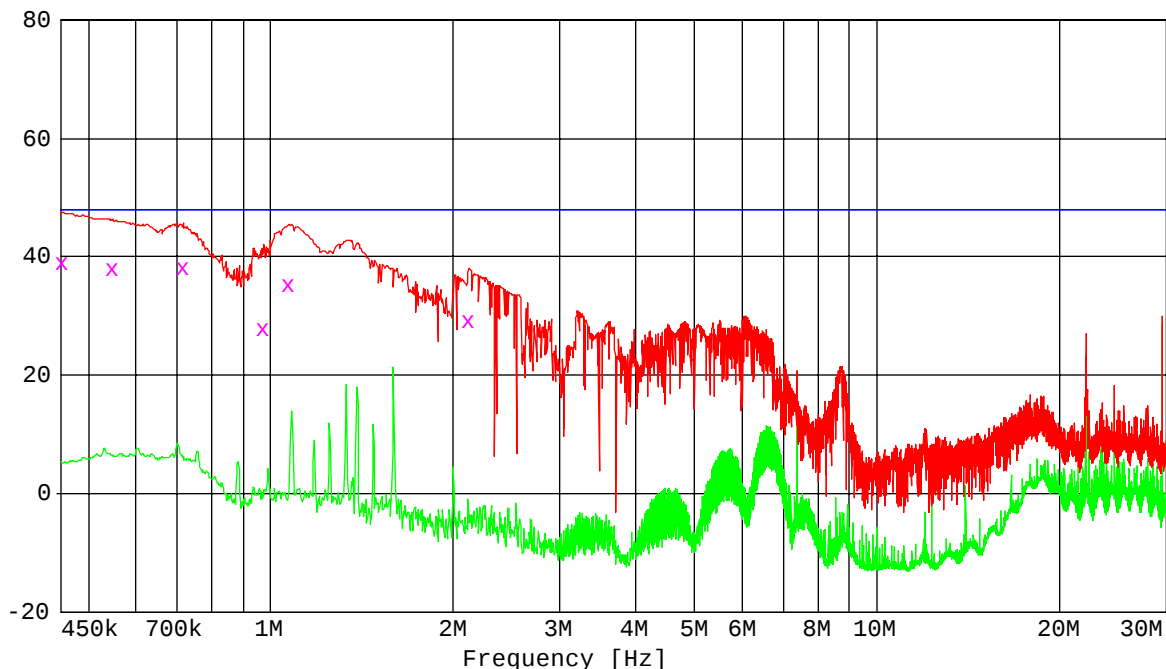
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Conducted Emissions Test

Comments: Device tested while hopping continuously using FCC hop pattern no 2 using a representative 110 Vac / 12 Vdc AC adaptor.

KEY			
Peak		Quasi Peak	X
Average		Average	+

Level [dBμV]



Quasi-Peak Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Exceed	Phase	Rechecks dBμV
0.452000	39.12	48.00	8.88		N	39.0
0.550000	37.90	48.00	10.10		L1	
0.718000	38.10	48.00	9.90		L1	36.8
0.974000	27.71	48.00	20.29		N	
1.070000	35.23	48.00	12.77		L1	
2.125000	29.08	48.00	18.92		L1	

Average Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Exceed	Phase	Rechecks dBμV
No Recorded Results						

Result: Complies with an 8.88 dB margin at 0.45200 MHz (Quasi Peak).

Section 15.209 – Radiated emissions

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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

Device observed operating between 902 – 928 MHz with the following specifications:

- only 51 channels out of a possible 102 are used
- channels are based upon a 250 kHz channel plan
- only even channel numbers are used
- the first channel, numbered 0, is centred on 902.500 MHz
- the last channel, numbered 100, is centred on 927.750 MHz

Testing was carried out using FCC Channel hopping sequence number 2 which hopped according to the following channel sequence:

10, 24, 66, 90, 12, 18, 54, 62, 100, 78, 56, 80, 42, 60, 20, 68, 98, 88, 76, 82, 40, 4, 26, 86, 48, 58, 92, 22, 0, 44, 38, 8, 50, 94, 84, 30, 70, 34, 64, 36, 2, 14, 28, 56, 96, 32, 6, 60, 74, 72, 46

The hop frequency is given by the following formula:

$$F(\text{MHz}) = 902.500 + N \cdot 0.25$$

Detailed below is a plot of all 51 channels with the spectrum analyser in peak hold mode.

51 channels observed in operation.

The device is required to operate between 902 – 928 MHz.

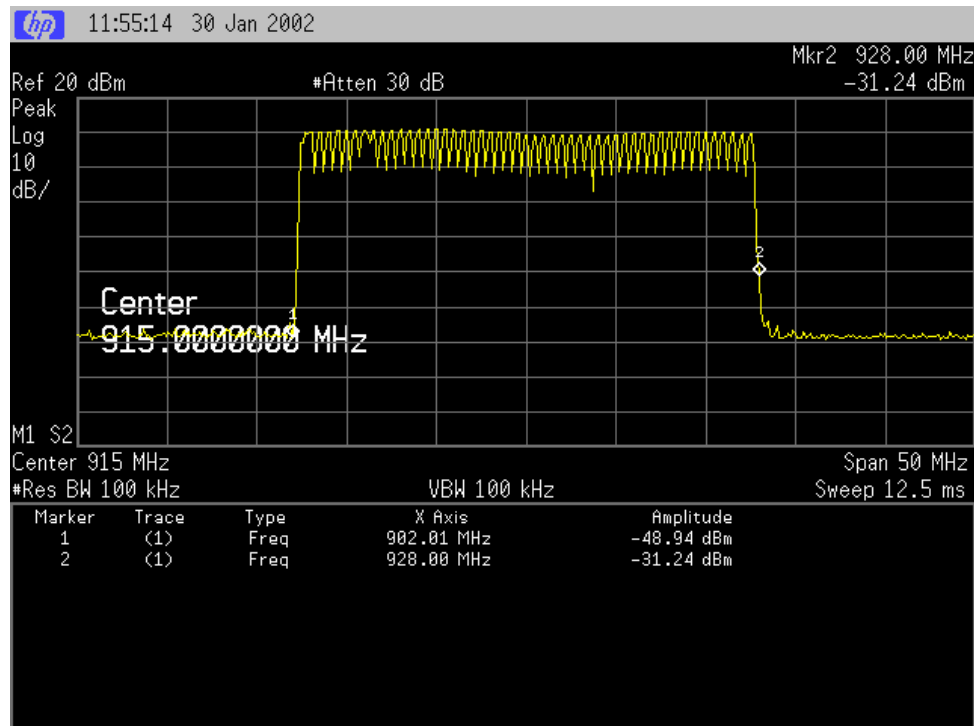
Band edge measurements have been made using a resolution bandwidth of 100 kHz that show that at the band edge the emission levels are significantly below the –20 dB requirement.

The plot shows that the –20 dB points are at approximately 902.300 and 927.800 MHz.

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The 20 dB bandwidth measurement was carried out on channel 46 which was the highest level channel observed.

The 20 dB bandwidth was determined to be 283 kHz.

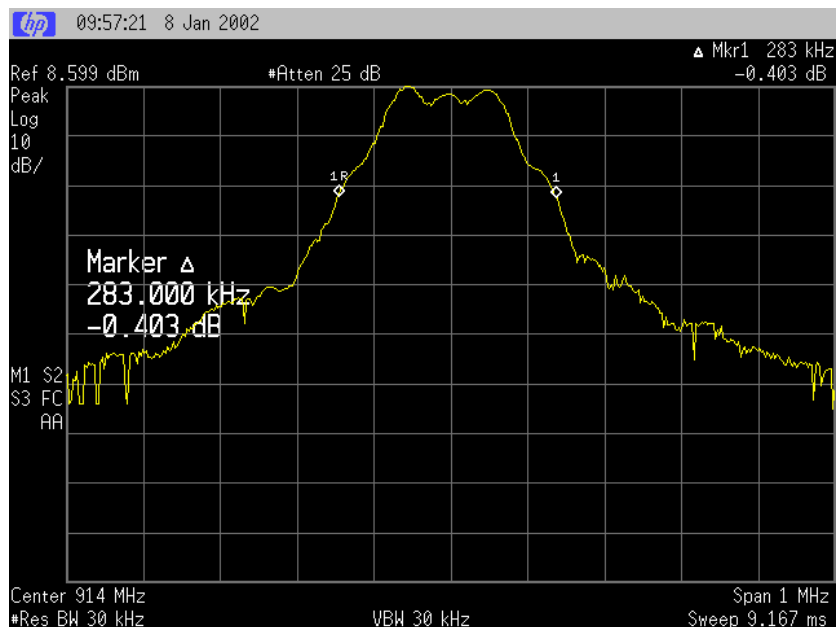
As the 20 dB bandwidth is greater than 250 kHz the system shall use at least 25 channels. This system uses 51 channels.

Below is a copy of the 20 dB bandwidth measurement.

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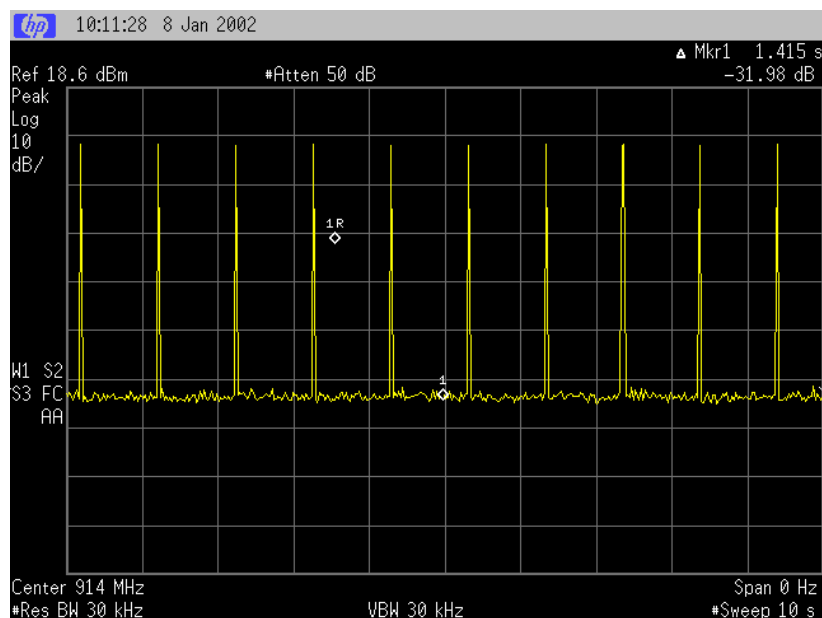
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Result: Complies

As the hopping channel bandwidth is greater than 250 kHz the average time of occupancy on each channel shall not be greater than 0.4 seconds (400 ms) within a 10 second period.

Observations were made on channel 46 with the spectrum analyser having a span of 0 Hz.



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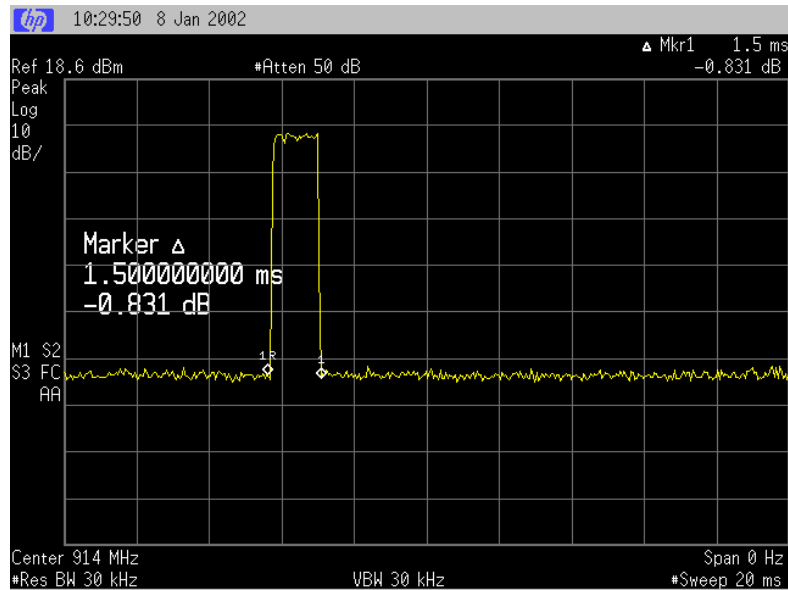
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In a 10 second period channel 46 was occupied 10 times.



Each time channel 46 was occupied for 1.55 ms.

$10 \times 1.50 \text{ ms} = 15 \text{ ms} = 0.015 \text{ seconds}$

Result: Complies

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Section 15.247 (b) (2) & (3) – Peak output power

Measurements were carried out at the RF output terminals of the transmitter using a 20 dB power attenuator and a spectrum analyser.

Measurements were carried out on channel 0, 46 and 100 using a span of 5 MHz and a resolution bandwidth of 1 MHz.

Measurements were made with the input voltage set to 110 Vac.

RF power output (dBm)			
Channel	Level	Rated	Limit
0	26.0	30.0	30.0
46	29.1	30.0	30.0
100	24.7	30.0	30.0

Variation of the input voltage by +/- 10% had not effect on the power output observed.

The antenna to be used with this system is a RF Industries Pty Ltd CD1625 Series GSM antenna.

This antenna has a gain of 3 dB over a dipole. Converting the antenna dB gain to dBi gives $3 + 2.15 = 5.15$ dBi.

As the antenna gain is less than 6 dBi the transmitter power need not be reduced.

A copy of the antenna specifications is contained in Appendix A.

Limits:

The maximum peak output power for frequency hopping systems operating in the 902 – 928 MHz shall not exceed 1 watts (+30 dBm) for systems employing at least 50 channels.

The peak output power of an intentional radiator shall be reduced below +30 dBm by the amount in dB that the antenna exceeds 6 dBi.

Result: Complies

Measurement Uncertainty: ± 0.5 dB

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Section 15.247 (b) (4) – Radio Frequency Hazard Information

As per Section 15.247 (b) (4) spread spectrum transmitters operating in the 902 – 928 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 f/1500 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:

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

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

$$E \text{ for MPE: } (902/1500) = E^2 / 3770$$

$$E = \sqrt{(902/1500) * 3770}$$

$$E = \underline{47.6 \text{ V/m}}$$

The antenna used with this system has a gain of 5.15 dBi (gain = 3.27) with the transmitter power measured being measured at 29.1 dBm or 0.815 watts.

Therefore:

$$\begin{aligned} d &= \sqrt{30 * P * G} / E \\ &= \sqrt{30 * 0.815 * 3.27} / 47.6 \\ &= \underline{0.188 \text{ metres or } 18.8 \text{ cm}} \end{aligned}$$

Calculations show that this device with the described antenna meets the MPE requirement for mobile devices falling below the 20 cm clearance required.

Result: Complies

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Section 15.247 (c) – Out of band emissions

Using a spectrum analyser and an external 20 dB attenuator the power reference level was determined to be +29.1 dBm.

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

Frequency: 914.000 MHz

Measured Spurious Emission		
Emission (MHz)	Emission level (dBm)	Limit (dBm)
Harmonics		
1828.000	-23.1	-10.9
2742.000	-29.3	-10.9
3656.000	-53.2	-10.9
4570.000	-45.8	-10.9
5484.000	-45.6	-10.9
6398.000	-44.3	-10.9
7312.000	-63.7	-10.9
8226.000	-69.3	-10.9
9194.000	-80.0	-10.9
Other emissions		
44.200	-59.9	-10.9
58.900	-54.2	-10.9
73.900	-52.6	-10.9
120.300	-29.1	-10.9
318.300	-34.0	-10.9
361.100	-26.1	-10.9
728.300	-31.5	-10.9
773.800	-33.4	-10.9
2184.300	-30.1	-10.9

Result: Complies

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. A limit of -10.9 dBm has been applied as the highest level of desired power observed was +9.1 dBm.

Measurement Uncertainty: ± 3.3 dB

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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 are required to be carried out with the limits as per section 15.209 applied.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Dakota Lane, Ardmore Aerodrome, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on February 11, 2000.

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.

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:

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

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Results:

Frequency MHz	Level		Recheck dBuV/m	Limit dBuV/m	Margin dBuV	Result	Worst Case Antenna
	Vertical dBuV/m	Horizontal dBuV/m					
*30.750	18.5			40.0	-	Pass	Vertical
*44.240	24.0			40.0	-	Pass	Vertical
*59.000	28.4			40.0	-	Pass	Vertical
*65.140	25.0			40.0	-	Pass	Vertical
73.748	39.8	35.3	39.9	40.0	0.2	Uncert	Vertical
*81.123	25.6			40.0	-	Pass	Vertical
*88.500	34.7			43.5	-	Pass	Vertical
*103.248	24.2			43.5	-	Pass	Vertical
110.623	17.6			43.5	25.9	Pass	Vertical
117.990	23.6			43.5	19.9	Pass	Vertical
132.750	25.1	21.3		43.5	18.4	Pass	Vertical
162.249	28.6	25.7		43.5	14.9	Pass	Vertical
*191.749	26.6	23.6		43.5	-	Pass	Vertical
*309.975	16.0	27.4		43.5	-	Pass	Horizontal
*339.249	27.3	32.8		43.5	-	Pass	Horizontal
*368.749	25.8	34.1		43.5	-	Pass	Horizontal
*1823.0	-	-		54.0	-	Pass	Vert/Hort
2734.5	48.6	39.5	55.2	54.0	1.2	Uncert	Vertical
3646.0	-	-		54.0	-	Pass	Vert/Hort
4557.5	-	-		54.0	-	Pass	Vert/Hort
5469.0	-	-		54.0	-	Pass	Vert/Hort
*6380.5	-	-		54.0	-	Pass	Vert/Hort
7292.0	-	-		54.0	-	Pass	Vert/Hort
8203.5	-	-		54.0	-	Pass	Vert/Hort
9115.0	-	-		54.0	-	Pass	Vert/Hort

* Measurement not required as this frequency falls outside of the restricted band frequencies.

Result: Complies. Measurement at 73.748MHz falls within the window of uncertainty for this test method with a margin of 0.2 dB.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 10,000 MHz) ± 4.1 dB

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8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset
Attenuator 20 dB	Hewlett Packard	8491B	22146	E1041
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198
Spectrum Analyser	Hewlett Packard	E 7405A	US 39150142	3776
Measurement Receiver	Rohde & Schwarz	ESCS 30	839873/1	E1595
Aerial Controller	EMCO	1090	9112-1062	3710
Aerial Mast	EMCO	1070-1	9203-1661	3708
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709
Biconical Antenna	Schwarzbeck	BBA 9106	-	3612
Log Periodic Antenna	Schwarzbeck	UHALP 9107	-	3702
Horn Antenna	EMCO	3115	9511-4629	E1526

9. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was updated on February 11th, 2000.

In addition testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to the New Zealand Code of Laboratory Management Practice incorporating ISO Guide 25: 1990 and ISO 9002: 1994.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 25 accreditation bodies in 21 economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

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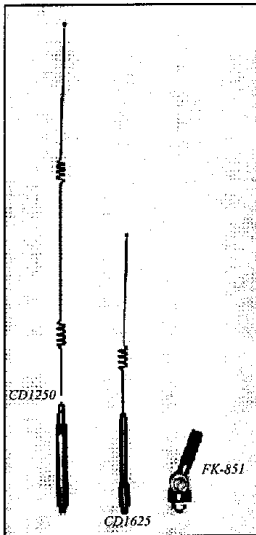
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Appendix A: Antenna specifications

Cellular Elevated Feed Antennas

825-960 MHz

CD1225 Series	3.0 dB - CDMA
CD1625 Series	3.0 dB - GSM
CD1228 Series	3.0 dB - Fender Mount - CDMA
CD1628 Series	3.0 dB - Fender Mount - GSM
CD1250 Series	5.0 dB - CDMA



Elevated Feed Antennas - these 'problem solvers' provide high performance in virtually any mounting position.

The elevated feed design raises the radiating element above the vehicle roof level to provide a strong omnidirectional pattern and high performance for vehicle gutter, fender, boot or magnetic mounting.

The whip and air wound phasing coil are constructed from a single piece of precipitation hardened stainless steel finished in stylish black plating. The elevated feed section is hand crafted from brass and finished with a black chrome plating.

- High performance omnidirectional gain
- 'Problem Solver' - Elevated feed design eliminates need for a ground plane and boosts the radiating element over obstructions
- Black finish will not scratch or peel
- Limited lifetime warranty

CDMA - 825-896 MHz

GSM - 890-960 MHz

3.0 dB Elevated Feed Antennas

- 3.0dB omni-directional gain elevated feed design eliminates need for ground plane
- Various mounting kits available

5.0 dB Elevated Feed Antennas (CDMA only)

- Designed primarily for country areas or fringe area locations
- High Performance - 5.0 dB omni-directional gain
- Elevated feed design eliminates need for ground plane
- Various mounting kits available



RF Industries Pty Ltd

www.rfindustries.com.au

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