

EMC Technologies (NZ) Ltd

Test Report No 40807.1a

Report date: 4 August 2004

TEST REPORT

Cardax Prox Plus Card Reader

tested to

47 Code of Federal Regulations

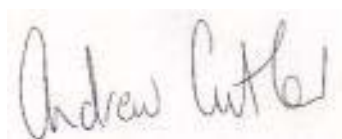
Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

for

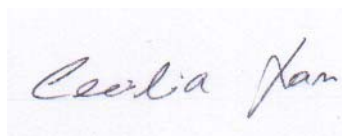
Gallagher Group Ltd

This Test Report is issued with the authority of:



Andrew Cutler - General Manager

Prepared By:



Cecilia Lam - Office Administrator



EMC Technologies (NZ) Ltd

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Page 1 of 22

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Test Report No 40807.1a

Report date: 4 August 2004

Table of Contents

1.	STATEMENT OF COMPLIANCE	3
2.	RESULTS SUMMARY	3
3.	INTRODUCTION	4
4.	CLIENT INFORMATION	4
5.	DESCRIPTION OF TEST SAMPLE	5
6.	RESULTS	5
7.	TEST EQUIPMENT USED	18
8.	ACCREDITATIONS	18
9.	PHOTOGRAPH (S)	19

EMC Technologies (NZ) Ltd

Test Report No 40807.1a

Report date: 4 August 2004

1. STATEMENT OF COMPLIANCE

The **Cardax Prox Plus Card Reader** complies with FCC Part 15 Subpart C as an Intentional Radiator when the methods, as described in ANSI C63.4 - 1992, are applied.

2. RESULTS SUMMARY

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required.
15.203	Antenna requirement	Complies. Antenna connector unique.
15.204	External PA and antenna modifications	Not applicable. No external devices.
15.205	Restricted bands of operation	Complies. Device transmits on 13.560 MHz
15.207	Conducted limits	Complies
15.209	Radiated emission limits	Complies with a 2.6 dB margin at 230.520 MHz (Horizontal).
15.225 a	Fundamental emission	Complies with a 51.0 dB margin
15.225 a-d	Fundamental emission mask	Complies.
15.225 e	Frequency tolerance	Complies

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Test Report No **40807.1a**

Report date: 4 August 2004

3. INTRODUCTION

This report describes the tests and measurements performed on the **Cardax Prox Plus Card Reader** 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.

This report replaces report 40333.1 in order to address several further issues raised by a Telecommunication Certification Body.

4. CLIENT INFORMATION

Company Name	Gallagher Group Ltd
Address	Private Bag 3026
City	Hamilton
Country	New Zealand
Contact	Mr Dave Grant

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Test Report No 40807.1a

Report date: 4 August 2004

5. DESCRIPTION OF TEST SAMPLE

Brand Name	Cardax
Model Number	Prox Plus
Product	Card Reader
Manufacturer	Gallagher Group Ltd
Country of Origin	New Zealand
Serial Number	0431161294 (PCB Serial No 0431161293)

Ancillary equipment

Alarm SAF MPS-U12030-B03-UL Power Support System (110 Vac to 12 Vdc external power supply). Serial number #049853.

Cardax 190200 Universal Reader Interface. Serial number #19841.

Photographs of this equipment are attached.

6. RESULTS

Standard

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

Methods and Procedures

The measurement methods and procedures as described in ANSI C63.4 - 1992 were used.

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device.

Section 15.203: Antenna requirement

As can be seen from the attached photographs the device has an internal unique antenna that cannot be easily accessed and therefore cannot be easily modified.

Result: Complies.

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Test Report No 40807.1a
Report date: 4 August 2004

Section 15.204: External radio frequency power amplifiers and antenna modifications

From the attached photographs it can be seen that it is not possible to attach an external power amplifier to this transmitter.

Result: Complies.

Section 15.205: Restricted bands of operation

The transmitter transmits on 13.561 MHz and is therefore covered by Section 15.225 of these rules.

Result: Complies.

Section 15.207: Conducted limits

Conducted emission testing has been carried out as this device is powered using a 110 Vac power supply which powers a Universal Card Reader Interface (URI) which in turn powers the transmitter.

Due to the affect of the transmitter on the conducted measurements, measurements have been made with the antenna attached and with the antenna replaced with a dummy load.

The device is deemed to comply if compliance is shown when a dummy load is attached.

Conducted emissions 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.

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

Measurement uncertainty with a confidence interval of 95% is:

- Mains terminal tests (0.15 - 30 MHz) $\pm$ 2.2 dB

Result: Complies.

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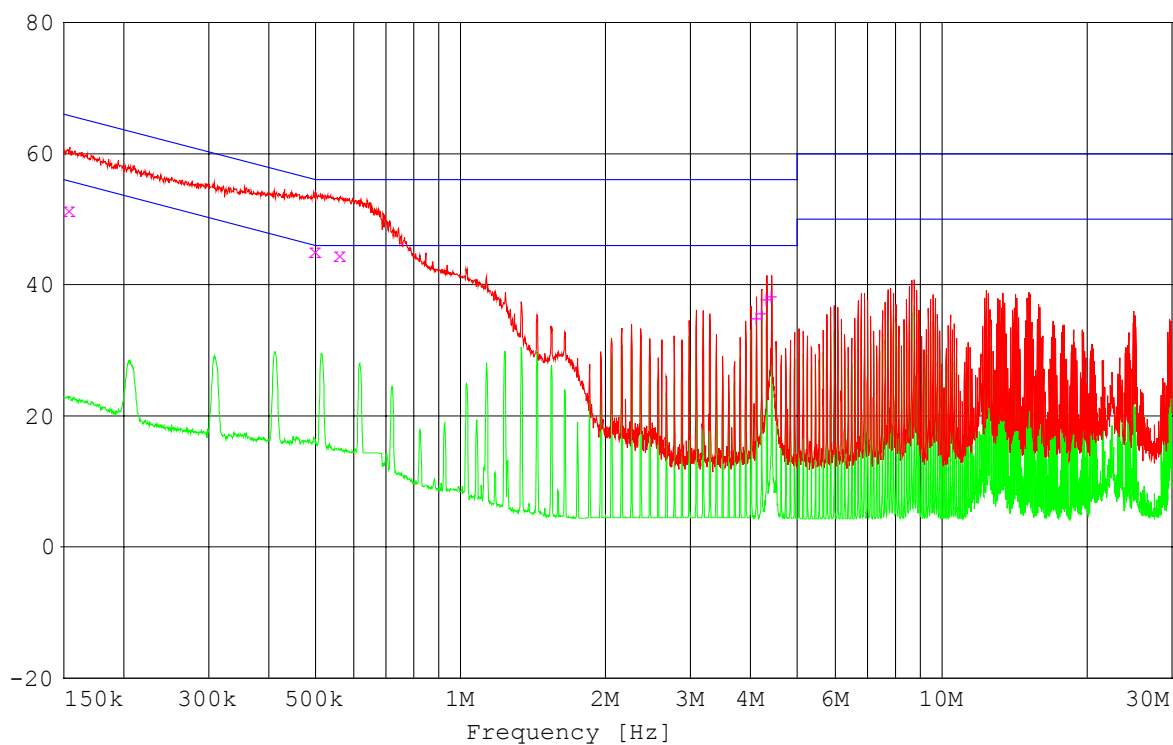
Test Report No 40807.1a

Report date: 4 August 2004

Conducted Emissions

Comments:	Device tested when powered at 110 Vac. Antenna replaced with a dummy load.
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Level [dB μ V]



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

Quasi-Peak Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Exceed	Phase	Rechecks dB μ V
0.154255	51.49	65.77	14.28		N	
0.500412	45.24	56.00	10.76		N	
0.563019	44.66	56.00	11.34		N	

Average Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Exceed	Phase	Rechecks dB μ V
4.115607	34.82	46.00	11.18		L1	
4.219742	35.60	46.00	10.40		L1	
4.322189	37.78	46.00	8.22		L1	
4.422700	38.26	46.00	7.74		L1	

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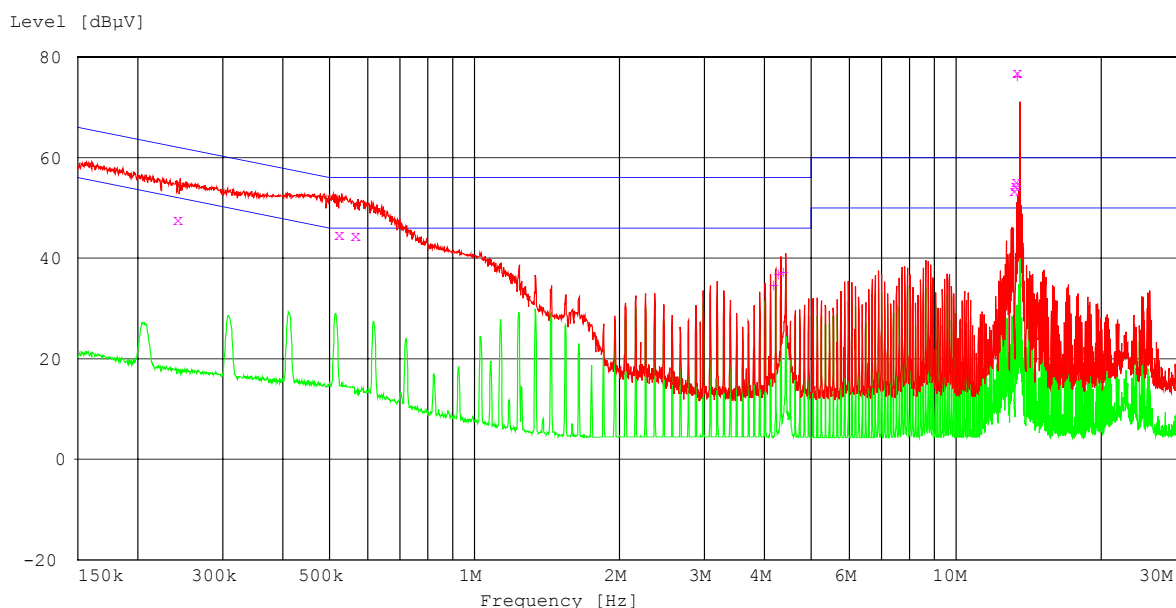
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Conducted Emissions

Comments:	Device tested when powered at 110 Vac. Antenna attached.
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Peak -----	Average -----	Quasi Peak X	Average +
------------	---------------	--------------	-----------

Quasi-Peak Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Exceed	Phase	Rechecks dBμV
0.244728	47.82	61.93	14.11		L1	
0.530263	44.77	56.00	11.23		N	
0.573235	44.55	56.00	11.45		N	
13.345754	53.43	60.00	6.57		N	
13.426029	54.50	60.00	5.50		N	
13.479814	55.28	60.00	4.72		N	
13.560895	76.96	60.00	-16.96	*	N	

Average Measurements

Frequency MHz	Level dBμV	Limit dBμV	Margin dB	Exceed	Phase	Rechecks dBμV
4.219742	34.65	46.00	11.35		L1	
4.322189	36.83	46.00	9.17		L1	
4.422700	37.26	46.00	8.74		L1	
13.560895	76.12	50.00	-26.12	*	N	

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Test Report No 40807.1a
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Section 15.209: Radiated emission limits, general requirements

Radiated emissions testing was carried out over the frequency range of 100 kHz to 1000 MHz for all other emissions other than the fundamental emission.

The fundamental emission is covered by Section 15.225.

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 on February 17th, 2004.

Testing was carried out at the laboratory's open area test site - located at Driving Creek, Orere Point, Auckland, New Zealand.

This site conforms to the requirements of CISPR 16, Part 1, Clause 16, and ANSI C63.4 - 1992.

The device was placed on the test tabletop, which is a total of 0.8 m above the test site ground plane.

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.

Above 30 MHz emissions are measured in both vertical and horizontal antenna polarisations, where appropriate.

Below 30 MHz measurements were made using a magnetic loop antenna that was orientated for the worst case emission level.

The emission level was 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

Test Report No 40807.1a

Report date: 4 August 2004

Section 15.209: Spurious Emissions (below 30 MHz)

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Result
27.120	24.5	49.5	25.0	Pass

Magnetic loop measurements were made at a distance of 10 metres.

Measurements were made while the device was being powered using a 110 Vac power supply.

A receiver with an average detector and a 9 kHz bandwidth was used between 125 – 490 kHz and a quasi peak detector with a 9 kHz bandwidth was used between 490 kHz – 30.0 MHz.

The 30 metre limit between 490 – 1705 kHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The spurious emission observed does not exceed the level of the fundamental emission.

Result: Complies with an 25.0 dB margin at 27.120 MHz.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (100 kHz – 30 MHz) $\pm$ 4.8 dB

EMC Technologies (NZ) Ltd

Test Report No 40807.1a

Report date: 4 August 2004

Section 15.209: Spurious Emissions (above 30 MHz)

Measurements between 30 – 1000 MHz have been made at a distance of 3 metres.

Measurements were made while the device was being powered using a 110 Vac power supply.

A receiver with a quasi peak detector with a 120 kHz bandwidth was used between 30 – 1000 MHz.

A number of transmitter spurious emissions and some digital device emissions were observed.

The limits as described in Section 15.209 have been applied as follows:

30.0 – 88.0 MHz	100 uV/m	40 dBuV/m
88.0 – 216.0 MHz	150 uV/m	43.5 dBuV/m
216.9 – 960.0 MHz	200 uV/m	46.0 dBuV/m

All emissions observed were below the level of the fundamental emission.

Result: Complies with a 2.6 dB margin at 230.520 MHz (Horizontal).

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 1000 MHz) $\pm$ 4.1 dB

EMC Technologies (NZ) Ltd

Test Report No **40807.1a**

Report date: 4 August 2004

Spurious Emissions

Transmitter harmonics

Frequency MHz	Level		Recheck dBuV/m	Limit dBuV/m	Margin dB	Result	Worst Case Antenna
	Vertical dBuV/m	Hort dBuV/m					
40.680	29.8			40.0	10.2	Pass	Vertical
54.240	27.1			40.0	12.9	Pass	Vertical
67.800	28.6			40.0	11.4	Pass	Vertical
81.360	22.0	20.5		40.0	18.0	Pass	Vertical
94.920	28.5			43.5	15.0	Pass	Vertical
108.480	30.3	24.5		43.5	13.2	Pass	Vertical
122.040	29.0	23.5		43.5	14.5	Pass	Vertical
135.600	36.8	27.6		43.5	6.7	Pass	Vertical
149.160	33.8	30.0		43.5	9.7	Pass	Vertical
162.720	35.6	36.9		43.5	6.6	Pass	Horizontal
176.280	31.9	31.3		43.5	11.6	Pass	Vertical
189.840	35.0	31.4		43.5	8.5	Pass	Vertical
203.400	29.4	31.1		43.5	12.4	Pass	Horizontal
216.960	32.7	37.3		46.0	8.7	Pass	Horizontal
230.520	42.6	43.4	42.5	46.0	2.6	Pass	Horizontal
244.080	35.2	38.0		46.0	8.0	Pass	Horizontal
257.640	31.5	32.1		46.0	13.9	Pass	Horizontal
271.200	22.6	25.0		46.0	21.0	Pass	Horizontal
284.760	20.0	22.0		46.0	24.0	Pass	Horizontal
298.320	25.3	24.9		46.0	20.7	Pass	Vertical
311.895	38.0	35.3		46.0	8.0	Pass	Vertical
325.455	25.8	26.7		46.0	19.3	Pass	Horizontal
393.255	33.0	31.0		46.0	13.0	Pass	Vertical
420.375	32.9	35.2		46.0	10.8	Pass	Horizontal
433.935	30.1			46.0	15.9	Pass	Vertical
447.495	31.0	32.9		46.0	13.1	Pass	Horizontal
501.735	31.1			46.0	14.9	Pass	Vertical
623.775	32.2			46.0	13.8	Pass	Vertical
637.335	31.3			46.0	14.7	Pass	Vertical
650.895	33.2			46.0	12.8	Pass	Vertical
678.015	31.7			46.0	14.3	Pass	Vertical

EMC Technologies (NZ) Ltd

Test Report No 40807.1a

Report date: 4 August 2004

Other emissions observed

Frequency MHz	Level		Recheck dBuV/m	Limit dBuV/m	Margin dB	Result	Worst Case Antenna
	Vertical dBuV/m	Hort dBuV/m					
32.000	21.8			40.0	18.2	Pass	Vertical
48.000	31.7			40.0	8.3	Pass	Vertical
54.240	26.4			40.0	13.6	Pass	Vertical
58.363	24.1			40.0	15.9	Pass	Vertical
61.435	26.6			40.0	13.4	Pass	Vertical
64.505	25.1			40.0	14.9	Pass	Vertical
67.575	31.0			40.0	9.0	Pass	Vertical
113.655	23.1			43.5	20.4	Pass	Vertical
120.013	23.3			43.5	20.2	Pass	Vertical

EMC Technologies (NZ) Ltd

Test Report No 40807.1a

Report date: 4 August 2004

Section 15.225 Operation in the band 13.110 – 14.010 MHz:

Section 15.225 (a)

The fundamental emission were observed to be operating on 13.560 MHz

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Voltage Vac	Result
13.561	50.8	104.0	53.2	93.7	Pass
13.561	51.0	104.0	53.0	110.0	Pass
13.561	51.0	104.0	53.0	126.5	Pass

Magnetic loop measurements were made at a distance of 10 metres.

Measurements were made while the device was being powered using a 110.0 Vac power supply.

A receiver with a quasi peak detector with a 9 kHz bandwidth was used to make this measurement.

The 30 metre limit been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The limits as per this section of 15,848 uV/m at 30 metres have been converted to dBuV/m using the formula $20 \cdot \log 15,848 \text{ uV/m} / 1 \text{ uV/m}$ to give a level of 84 dBuV/m.

10 metres is half a decade when compared to 30 metres.

Therefore the 84 dBuV/m limit at 30 metres is increased by 20 dB to give a limit of 104 dBuV/m at 10 metres.

At this frequency the supply voltage of 110 Vac was varied from 85% to 115%.

A very slight variation was observed.

Result: Complies with a 53.0 dB margin.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

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Test Report No 40807.1a

Report date: 4 August 2004

Section 15.225 (b), (c), (d)

In accordance with this subparts relative measurements were made in the laboratory using a spectrum analyser around the fundamental emission to determine the level of emissions close to the carrier.

On the attached spectrum plot the reference level is the fundamental emission limit of 104 dBuV/m. The emission level at 13.560 MHz was observed to be 51.0 dBuV/m.

The fundamental emission peak has therefore been placed 53.0 dB down on the reference level.

The emission mask steps have been determined as follows:

- Within the band 13.553 – 13.567 MHz. 15.848 uV/m = 84 dBuV/m at 30 metres which equals 104 dBuV/m at 10 metres
- Within the band 13.410 - 13.553 MHz and 13.567 – 13.710 MHz. 334 uV/m = 50.5 dBuV/m at 30 metres which equals 70.5 dBuV/m at 10 metres
- Within the band 13.110 - 13.410 MHz and 13.710 – 14.010 MHz. 106 uV/m = 40.5 dBuV/m at 30 metres which equals 60.5 dBuV/m at 10 metres
- Outside of the band 13.110 - 14.010 MHz. 30 uV/m = 29.5 dBuV/m at 30 metres which equals 49.5 dBuV/m at 10 metres

Two plots have been provided.

One has a span of 100 kHz and the other has a span of 2 MHz.

Result: Complies.

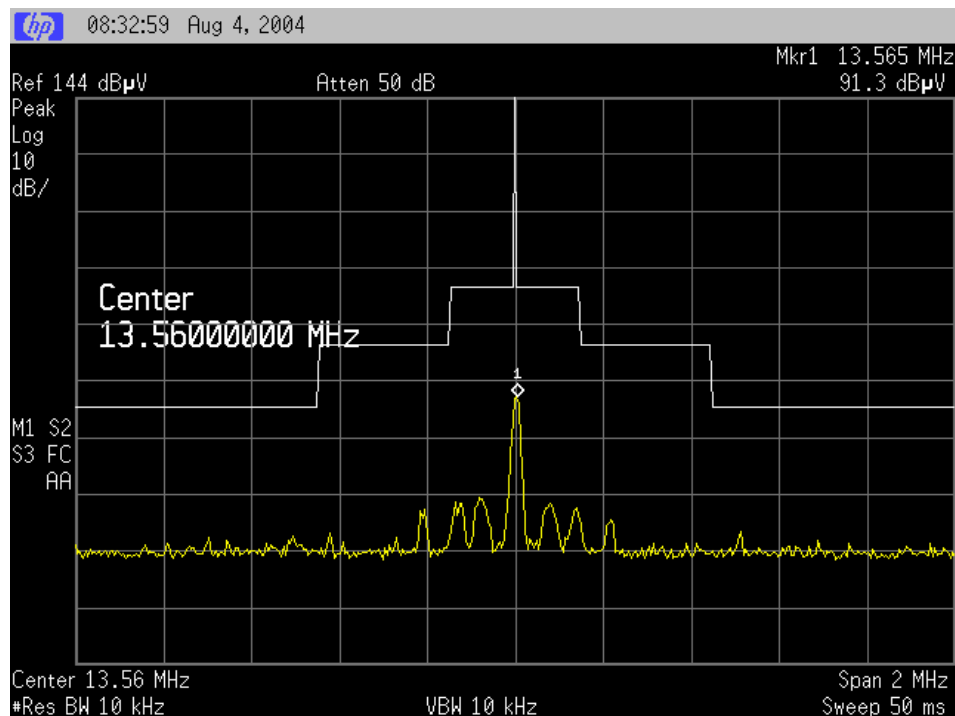
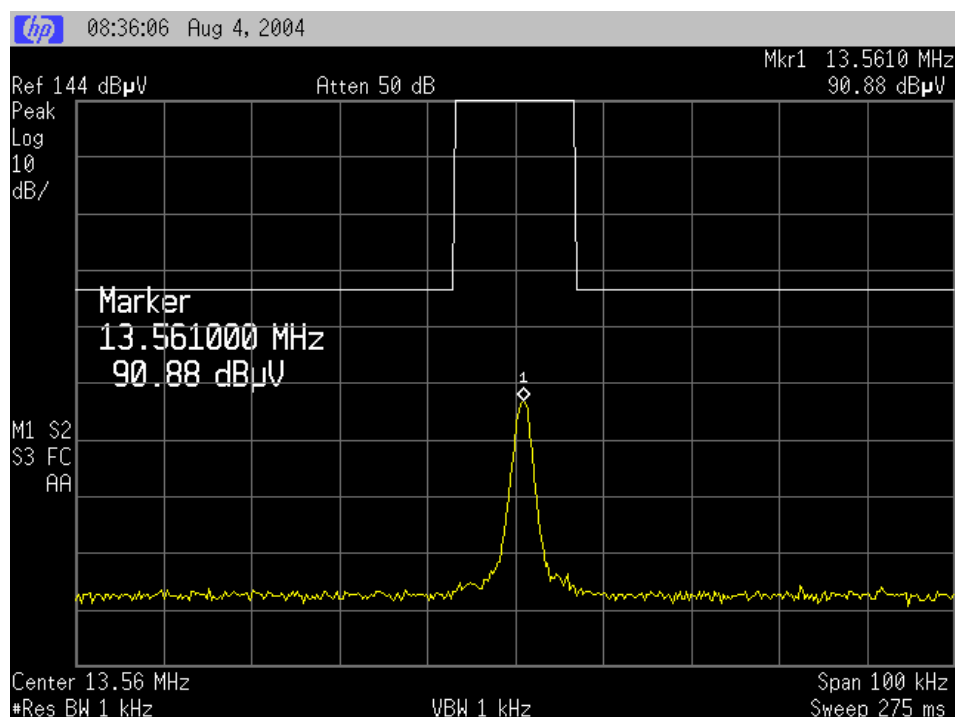
Measurement uncertainty with a confidence interval of 95% is:

- Frequency ± 50 Hz
- Amplitude ± 1.0 dB

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Section 15.225 (e)

Frequency tolerance measurements were made over the range of -20 to +50 degrees at the normal supply voltage in 10 degree increments.

In addition the normal supply voltage was varied from 85% to 115% at +20 degrees.

The frequency of operation is 13.561 MHz.

The frequency tolerance of +/- 0.001% gives a range of 13.559 6439 to 13.562 3561 MHz.

Temp (degrees)	Voltage 85%	Voltage Normal	Voltage 115%
-20.0	13.560 530	13.560 550	13.560 550
-10.0	13.560 550	13.560 600	13.560 600
0.0	13.560 600	13.560 650	13.560 650
+10.0	13.560 600	13.560 650	13.560 650
+20.0	13.560 600	13.560 650	13.560 650
+30.0	13.560 600	13.560 650	13.560 650
+40.0	13.560 600	13.560 650	13.560 650
+50.0	13.560 600	13.560 650	13.560 650

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Frequency $\pm$ 50 Hz

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Test Report No **40807.1a**
Report date: 4 August 2004

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Calibration due
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	Not applicable
Aerial Mast	EMCO	1070-1	03-1661	RFS 3708	Not applicable
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	12 May 2005
Log Periodic Antenna	Schwarzbeck	VUSLP9111	9111-228	RFS 3702	5 November 2004
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776	10 Sept 2004
Measurement Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595	20 October 2004
Measurement Receiver	Rohde & Schwarz	ESHS 10	828404/005	RFS 3728	12 February 2005
Loop Antenna	Schwarzbeck	FMZ 1514	-	RFS 3602	26 July 2006
Magnetic Loops	Schwarzbeck	FMZ 15141	-	RFS 3653	26 July 2006
Magnetic Loops	Schwarzbeck	FMZ 15142	-	RFS 3654	26 July 2006
Artificial Mains Network	Rohde & Schwarz	ESH2-Z5	881362/034	RFS 3628	15 March 2006
Variac	General Radio	1592	-	RFS 3690	Not applicable
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applicable
VHF Balun Antenna	Schwarzbeck	VHA 9103		RFS 3603	12 May 2005

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 on February 17th, 2004.

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 17025.1999.

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 17025.1999.

International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 46 accreditation bodies in 34 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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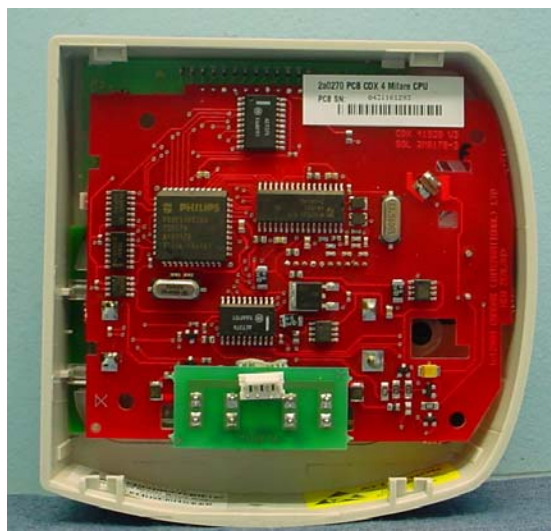
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9. PHOTOGRAPH (S)

Device tested



Labels



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Radiated emissions test set up



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Ancillaries set up at the open area test site



Conducted emissions test set up



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