EMC Technologies (NZ) Ltd

Test Report No **50534.1**
Report date: 27 May 2005

TEST REPORT

Cardax IDT Mifare 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

EMC Technologies (NZ) Ltd
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1. STATEMENT OF COMPLIANCE

The **Cardax IDT Mifare 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 with a 1.5 dB margin at 29.9675 MHz (Average).
15.209	Radiated emission limits	Complies with a 4.0 dB margin at 50.0 MHz (Vertical).
15.225 a	Fundamental emission	Complies with a 56.0 dB margin.
15.225 a-d	Fundamental emission mask	Complies.
15.225 e	Frequency tolerance	Complies

3. INTRODUCTION

This report describes the tests and measurements performed on the **Cardax IDT Mifare 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.

4. CLIENT INFORMATION

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

5. DESCRIPTION OF TEST SAMPLE

Brand Name Cardax

Model Number IDT Mifare

Product Card Reader

Manufacturer Gallagher Group Ltd

Country of Origin New Zealand

Serial Number

Ancillary equipment

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

Cardax FT Controller 5000 (Part no: C200111). Serial number #0023340123.

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.

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.

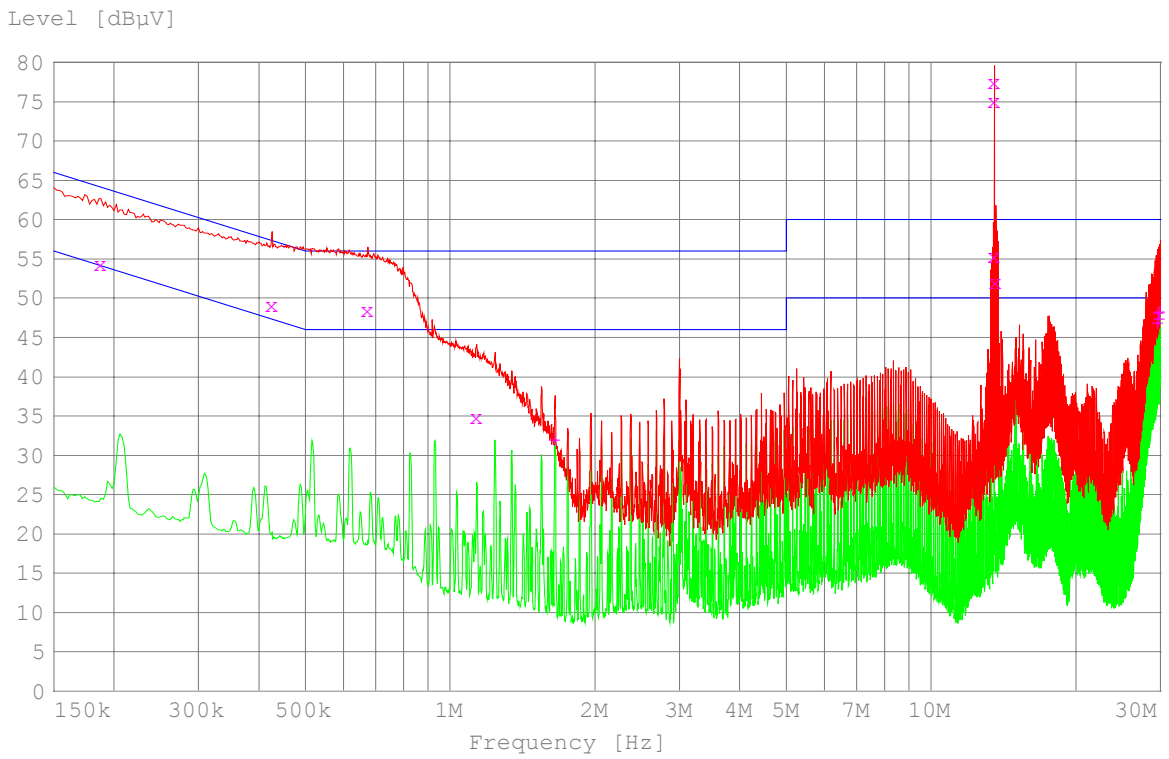
Measurements on both the phase and neutral lines were made using either a Quasi Peak or an Average detector with a 9 kHz bandwidth.

Measurement uncertainty with a confidence interval of 95% is:
- Mains terminal tests (0.15 - 30 MHz) ± 2.2 dB

Result: Complies.

Conducted emissions

Comments:	*Device tested using 110V AC. The EUT was operating under normal conditions. Antenna connected.*



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

Quasi-Peak Measurements

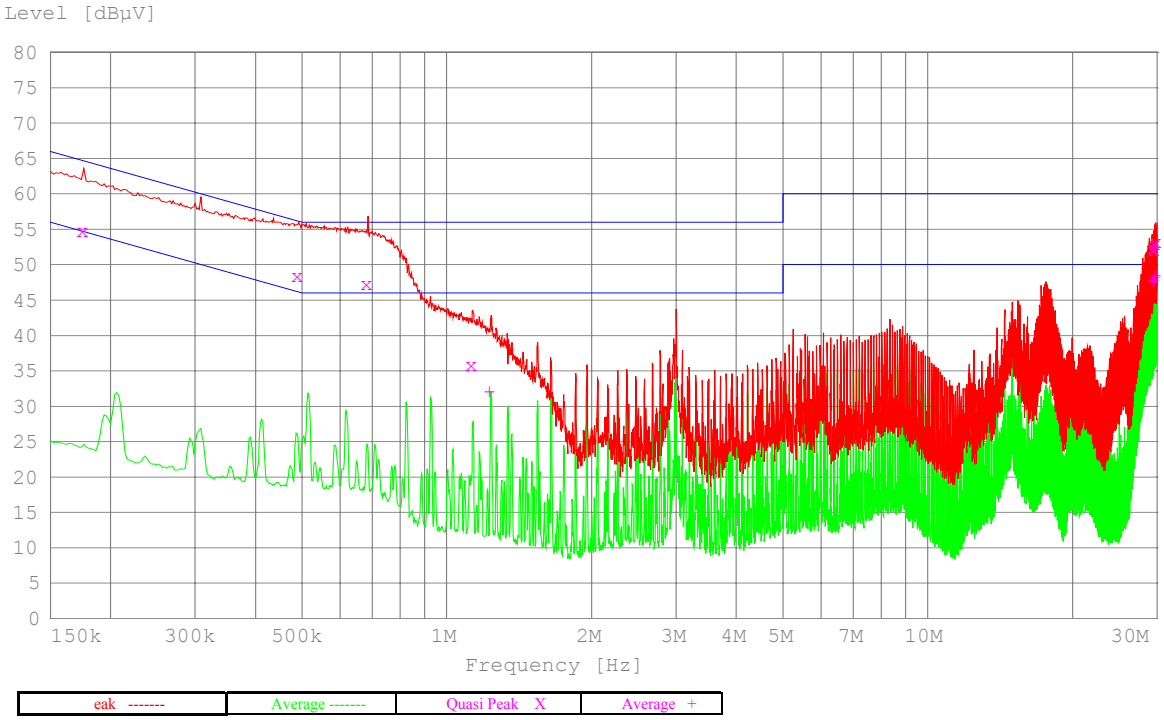
Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Exceed	Phase	Rechecks dBµV
0.188000	54.43	64.12	9.69		N	
0.426000	49.14	57.33	8.19		N	
0.674000	48.53	56.00	7.47		L1	
1.136000	34.84	56.00	21.16		N	
13.547500	55.38	60.00	4.62		N	Fundamental
13.555000	75.18	60.00	-15.18		N	Fundamental
13.560000	77.52	60.00	-17.52		L1	Fundamental
13.637500	52.12	60.00	7.88		N	Fundamental

Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Exceed	Phase	Rechecks dBµV
1.652000	32.07	46.00	13.93		L1	
29.675000	46.90	50.00	3.10		L1	
29.775000	48.20	50.00	1.80		L1	
29.880000	47.41	50.00	2.59		L1	
29.982500	48.36	50.00	1.64		L1	

Conducted emissions

Comments:	*Device tested using 110V AC. The EUT was operating under normal conditions. Dummy load connected.*



Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Exceed	Phase	Rechecks dBµV
0.176000	54.84	64.67	9.83		N	
0.492000	48.39	56.13	7.75		N	
0.686000	47.39	56.00	8.61		N	
1.132000	35.87	56.00	20.13		L1	
29.657500	52.36	60.00	7.64		L1	
29.765000	52.20	60.00	7.80		L1	
29.865000	53.02	60.00	6.98		L1	
29.970000	53.23	60.00	6.77		L1	

Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Exceed	Phase	Rechecks dBµV
1.236000	32.13	46.00	13.87		L1	
29.657500	47.68	50.00	2.32		L1	
29.762500	47.84	50.00	2.16		L1	
29.865000	48.14	50.00	1.86		L1	
29.967500	48.50	50.00	1.50		L1	

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:

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

Section 15.209: Spurious Emissions (below 30 MHz)

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Result
27.120	12.6	49.5	36.9	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 fundament emission.

Result: Complies with a 36.9 dB margin at 27.120 MHz.

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

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
216.0 – 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 4.0 dB margin at 50.0 MHz (Vertical).

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 1000 MHz) ± 4.1 dB

Spurious emissions

Frequency	Level		Recheck	Limit	Margin	Result	Worst Case
	Vertical	Hort					Antenna
MHz	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB		
30.000	30.0			40.0	10.0	Pass	Vertical
30.460	31.1			40.0	8.9	Pass	Vertical
31.460	32.2			40.0	7.8	Pass	Vertical
33.457	31.6			40.0	8.4	Pass	Vertical
34.440	32.0			40.0	8.0	Pass	Vertical
36.440	27.4			40.0	12.6	Pass	Vertical
38.420	32.1			40.0	7.9	Pass	Vertical
45.450	29.3			40.0	10.7	Pass	Vertical
48.000	34.1			40.0	5.9	Pass	Vertical
50.000	36.0			40.0	4.0	Pass	Vertical
55.550	26.2			40.0	13.8	Pass	Vertical
60.000	26.3			40.0	13.7	Pass	Vertical
66.000	26.0			40.0	14.0	Pass	Vertical
72.000	23.6			40.0	16.4	Pass	Vertical
75.000	20.0			40.0	20.0	Pass	Vertical
84.000	24.7			40.0	15.3	Pass	Vertical
87.770	20.8			40.0	19.2	Pass	Vertical
88.175	20.1			43.5	23.4	Pass	Vertical
94.730	22.9			43.5	20.6	Pass	Vertical
95.730	22.2			43.5	21.3	Pass	Vertical
97.730	22.4			43.5	21.1	Pass	Vertical
101.720	22.9			43.5	20.6	Pass	Vertical
102.120	24.7			43.5	18.8	Pass	Vertical
113.670	22.3			43.5	21.2	Pass	Vertical
120.000	29.5			43.5	14.0	Pass	Vertical
126.000	27.1			43.5	16.4	Pass	Vertical
138.000	28.6			43.5	14.9	Pass	Vertical
144.000	31.7	23.7		43.5	11.8	Pass	Vertical
146.570	26.3			43.5	17.2	Pass	Vertical
150.000	32.4	23.4		43.5	11.1	Pass	Vertical
152.390	29.5			43.5	14.0	Pass	Vertical
156.000	34.5	25.7		43.5	9.0	Pass	Vertical
162.000	29.6			43.5	13.9	Pass	Vertical
168.000	36.2	26.3		43.5	7.3	Pass	Vertical
180.000	28.3	24.3		43.5	15.2	Pass	Vertical
186.000	31.0			43.5	12.5	Pass	Vertical
192.000	30.9	26.9		43.5	12.6	Pass	Vertical

Spurious emissions continued

Frequency	Level		Recheck	Limit	Margin	Result	Worst Case
	Vertical	Hort					Antenna
MHz	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB		
200.000	24.7			43.5	18.8	Pass	Vertical
222.050	22.0	28.2		46.0	17.8	Pass	Horizontal
228.000	26.0	31.1		46.0	14.9	Pass	Horizontal
240.000	25.9	31.4		46.0	14.6	Pass	Horizontal
252.000	22.8	31.2		46.0	14.8	Pass	Horizontal
263.995	27.8	29.7		46.0	16.3	Pass	Horizontal
270.000	27.3	37.1		46.0	8.9	Pass	Horizontal
275.987	34.0	33.8		46.0	12.0	Pass	Vertical
282.050	33.9	32.6		46.0	12.1	Pass	Vertical
288.000	38.0	29.5		46.0	8.0	Pass	Vertical
293.995	32.8	27.8		46.0	13.2	Pass	Vertical
300.000	38.2	35.4		46.0	7.8	Pass	Vertical
312.000	36.3	26.6		46.0	9.7	Pass	Vertical
324.000	30.6	22.8		46.0	15.4	Pass	Vertical
360.000	29.8	25.6		46.0	16.2	Pass	Vertical
372.000	30.3	22.3		46.0	15.7	Pass	Vertical
450.000	30.7	21.9		46.0	15.3	Pass	Vertical
462.000	31.7	21.7		46.0	14.3	Pass	Vertical
474.000	31.8	20.5		46.0	14.2	Pass	Vertical
504.000	31.7	27.3		46.0	14.3	Pass	Vertical
528.000	32.9	28.0		46.0	13.1	Pass	Vertical
600.000	31.8	31.2		46.0	14.2	Pass	Vertical
734.000	29.4	26.0		46.0	16.6	Pass	Vertical
798.000	34.0	30.5		46.0	12.0	Pass	Vertical
894.000	31.7	29.4		46.0	14.3	Pass	Vertical
930.000	33.1	31.1		46.0	12.9	Pass	Vertical
978.000	32.9	32.0		54.0	21.1	Pass	Vertical

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	48.0	104.0	56.0	93.7	Pass
13.561	48.0	104.0	56.0	110.0	Pass
13.561	48.0	104.0	56.0	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*log 15,848 uV/m / 1 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%.

No variation in field strength was observed.

Result: Complies with a 56.0 dB margin.

Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

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 48.0 dBuV/m.
The fundamental emission peak has therefore been placed 56.0 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

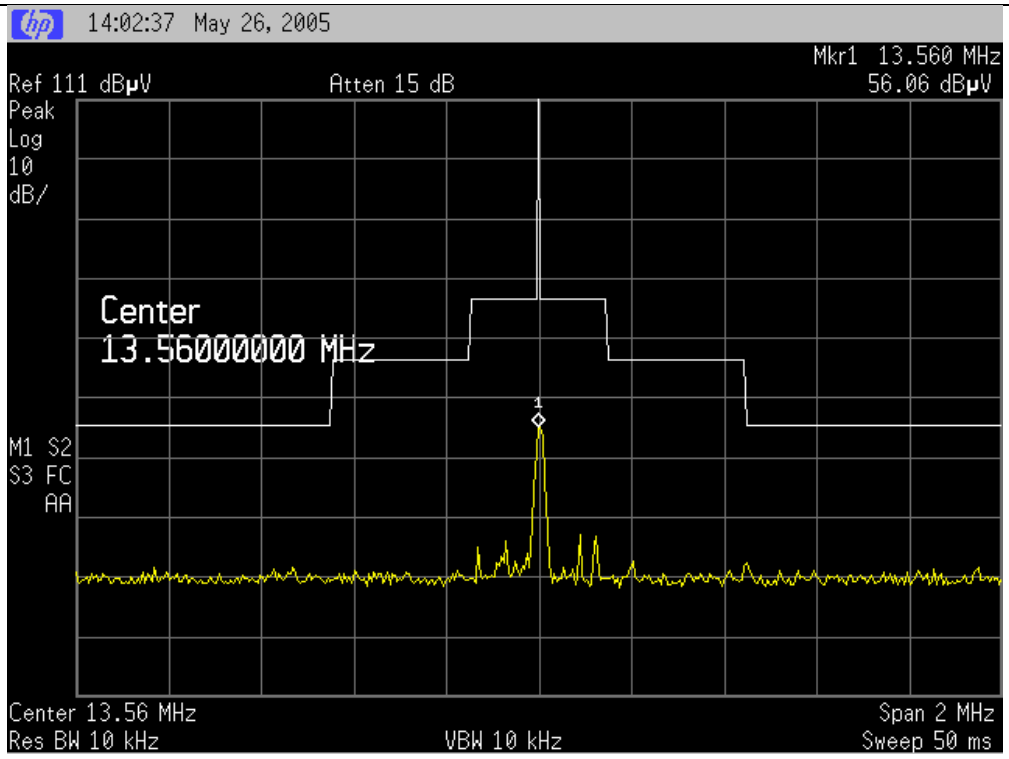
- Within the band 13.110 - 13.410 MHz and 13.710 – 14.010 MHz. 106 uV/m = 40.5 dBuV/m at 30 metres which equals 60.5 dBuV/m at 10 metres

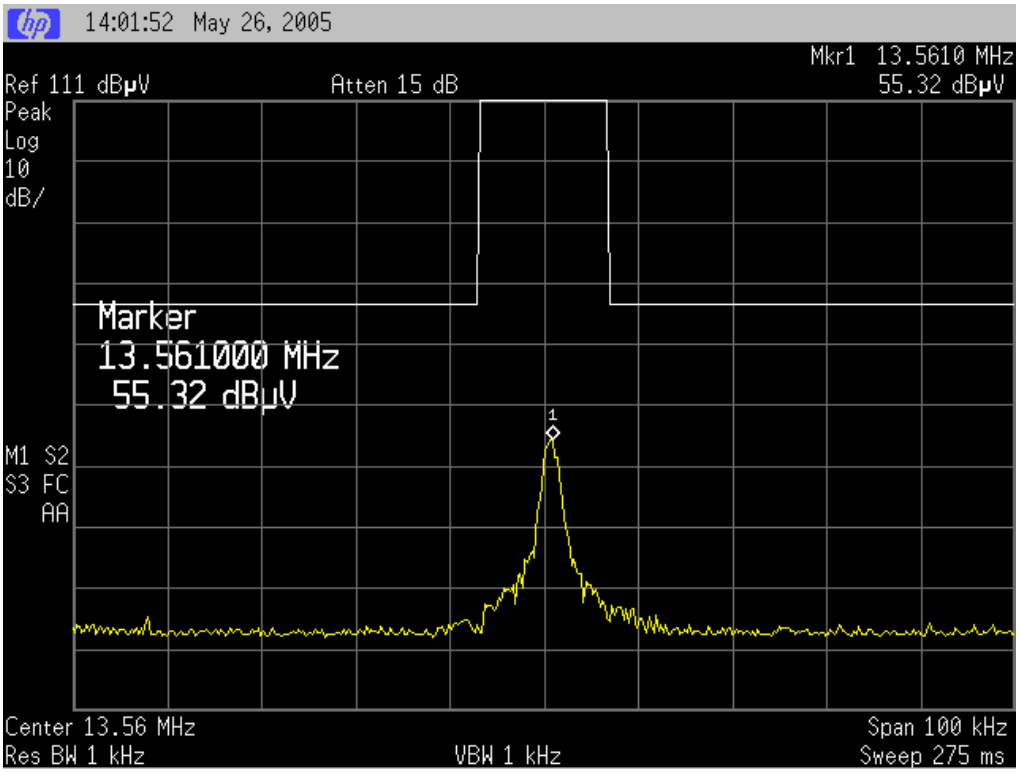
- Outside of the band 13.110 - 14.010 MHz. 30 uV/m = 29.5 dBuV/m at 30 metres which equals 49.5 dBuV/m at 10 metres

Two plots have been provided for this.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
- Frequency ± 50 Hz
- Amplitude ± 1.0 dB





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	13.561 000	13.561 000	13.561 000
-10.0	13.561 000	13.561 000	13.561 000
0.0	13.561 000	13.561 000	13.561 000
+10.0	13.560 900	13.560 900	13.560 900
+20.0	13.560 800	13.560 800	13.560 800
+30.0	13.560 800	13.560 800	13.560 800
+40.0	13.560 800	13.560 800	13.560 800
+50.0	13.560 800	13.560 800	13.560 800

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:
- Frequency ± 50 Hz

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 2006
Log Periodic Antenna	Schwarzbeck	VUSLP9111	9111-228	RFS 3702	5 November 2005
Spectrum Analyser	Hewlett Packard	E7405A	US39150142	3776	10 Sept 2005
Measurement Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595	20 October 2005
Measurement Receiver	Rohde & Schwarz	ESHS 10	828404/005	RFS 3728	12 February 2006
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 2006

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.

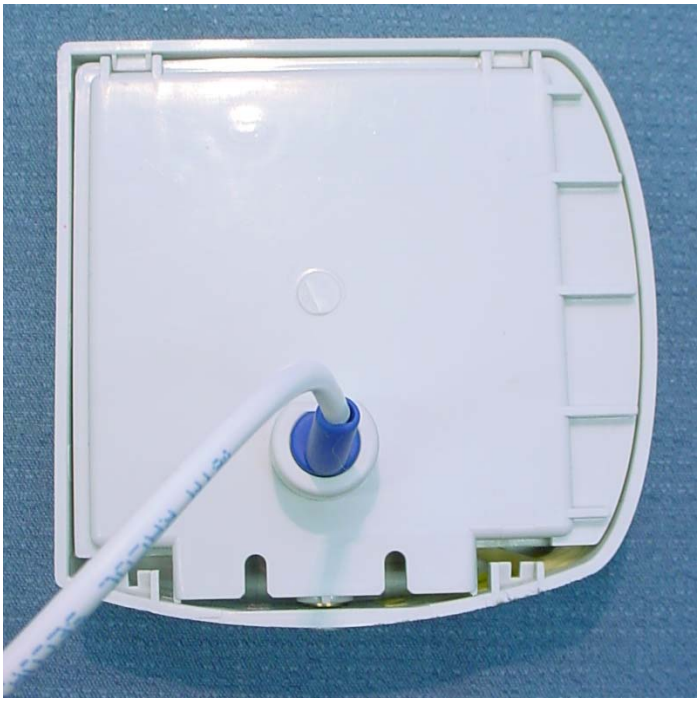
All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.1999.

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.

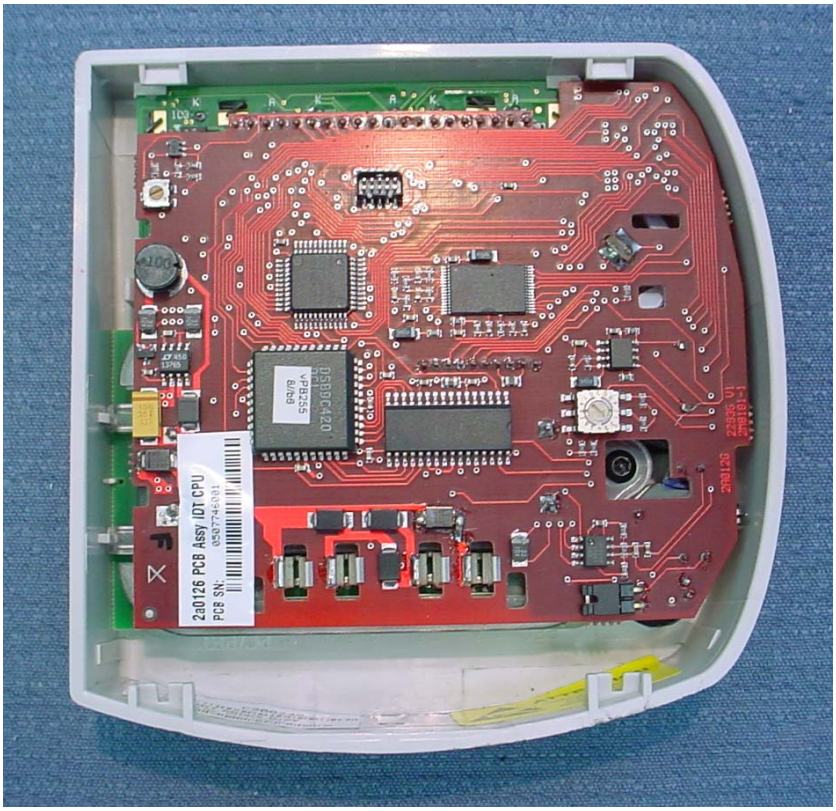
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with 46 accreditation bodies in 34 economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied on request.

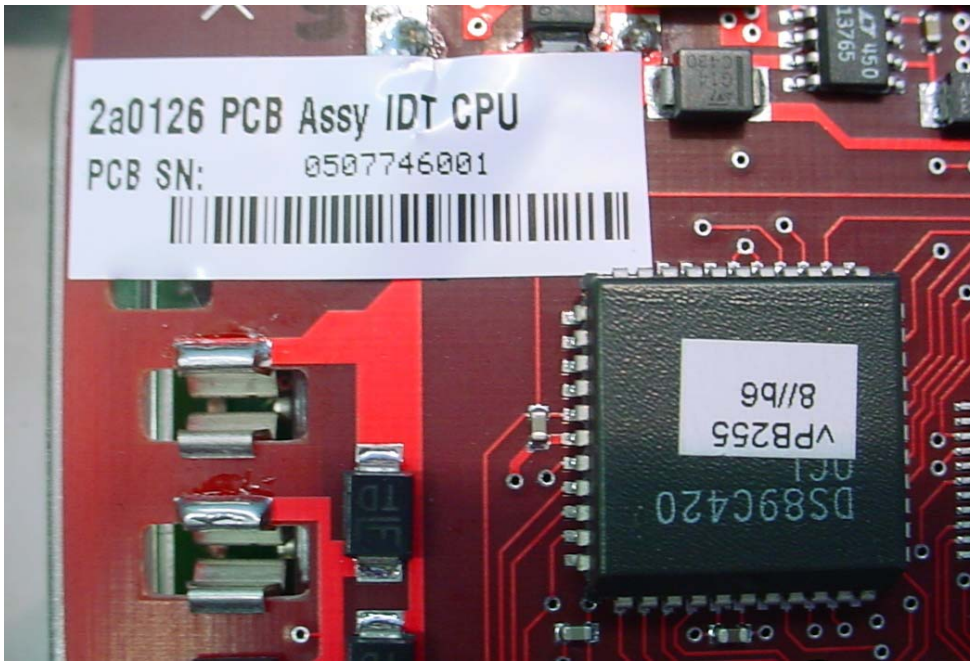
9. PHOTOGRAPH (S)

Device tested – External View



Internal View





Radiated emissions test set up

Conducted emissions test set up which includes the ancillaries