

EMC Technologies (NZ) Ltd

Test Report No 70403.1

Report date: 01 May 2007

TEST REPORT

Cardax Mifare Prox Reader (Teardrop) Proximity Card Reader

tested to

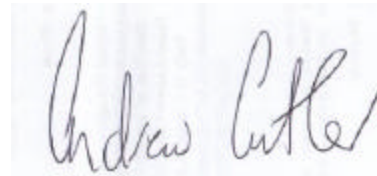
47 Code of Federal Regulations

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 Mifare Prox Reader (Teardrop) Proximity Card Reader** complies with FCC Part 15 Subpart C as an Intentional Radiator when the methods described in ANSI C63.4 - 2003 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 3.9 dB margin at 13.56 MHz (Average).
15.209	Radiated emission limits	Complies with a 0.0 dB margin at 68.700 MHz (Vertical).
15.225 a	Fundamental emission	Complies with a 60.5 dB margin.
15.225 a-d	Fundamental emission mask	Complies.
15.225 e	Frequency tolerance	Complies

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3. INTRODUCTION

This report describes the tests and measurements performed on the **Cardax Mifare Prox Reader (Teardrop) Proximity 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 Peter Jackson

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5. DESCRIPTION OF TEST SAMPLE

Brand Name	Cardax
Model Number	Mifare Prox Reader (Teardrop)
Product	Proximity Card Reader
Manufacturer	Gallagher Group Ltd
Country of Origin	New Zealand
Serial Number	0713450131
FCC ID	M5VC19753X

Ancillary equipment

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

Cardax FT G Bus URI (Universal Reader Interface).
Serial number# 0622250050.

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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 - 2003 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 13.560 MHz and is therefore covered by Section 15.225 of these rules.

Result: Complies.

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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 the fundamental emission is reduced and all other emissions remain approximately the same.

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.

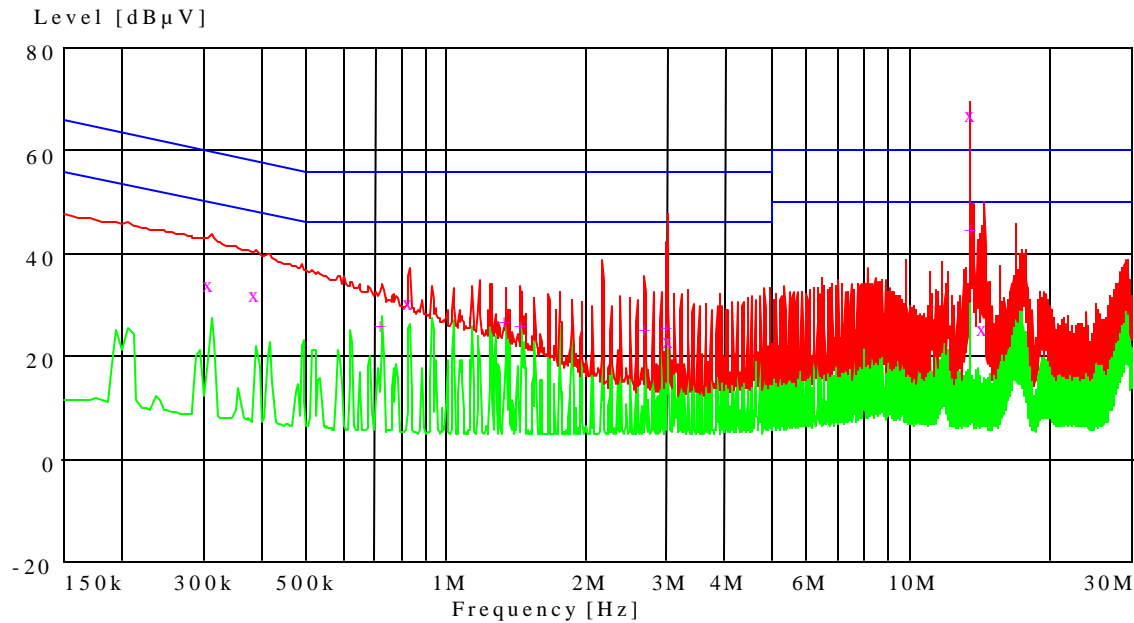
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Conducted emissions

Comments:	The EUT was powered at 115Vac using a representative power supply with the red light on the URI flashing and the transmitter transmitting continuously on 13.560 MHz.
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Peak -----	Average -----	Quasi Peak X	Average +
------------	---------------	--------------	-----------

Quasi-Peak Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.310000	35.00	59.9	24.9	N	
0.390000	32.80	58.0	25.2	N	
0.830000	31.50	56.0	24.5	N	
3.020000	24.10	56.0	31.9	N	
13.560000	68.10	60.0	-8.1	L1	
14.490000	26.30	60.0	33.7	L1	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.725000	27.50	46.0	18.5	N	
1.345000	28.00	46.0	18.0	N	
1.450000	27.10	46.0	18.9	N	
2.690000	26.60	46.0	19.4	N	
3.000000	26.80	46.0	19.2	N	
13.560000	46.10	50.0	3.9	L1	

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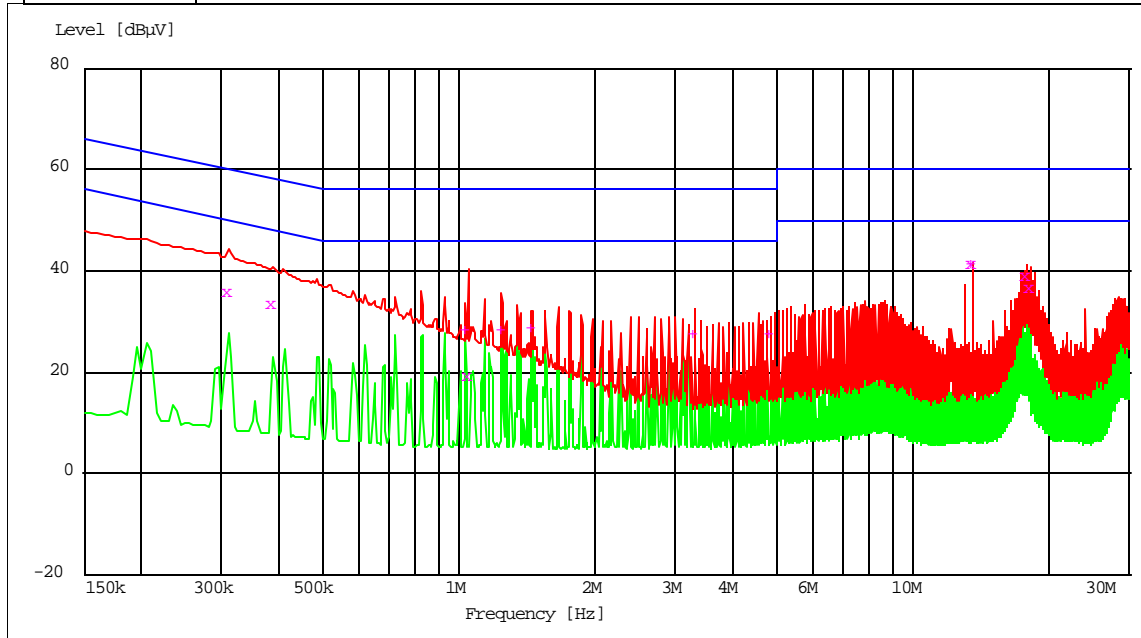
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Conducted emissions

Comments:	Device tested transmitting continuously with the antenna replaced by a dummy load while being powered using a representative 110 Vac powered supply and URI.
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Peak -----	Average -----	Quasi Peak X	Average +
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Quasi-Peak Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
0.310000	35.40	59.9	24.5	N	41.0
0.390000	32.70	58.0	25.3	N	
1.050000	18.60	56.0	37.4	L1	
13.560000	40.90	60.0	19.1	L1	
17.790000	38.60	60.0	21.4	L1	
18.090000	36.00	60.0	24.0	N	

Average Measurements

Frequency MHz	Level dBmV	Limit dBmV	Margin dB	Phase	Rechecks dBmV
1.035000	27.80	46.0	18.2	N	
1.240000	27.80	46.0	18.2	N	
1.450000	28.00	46.0	18.0	N	
3.310000	26.90	46.0	19.1	N	
4.860000	26.90	46.0	19.1	N	
13.560000	40.90	50.0	9.1	L1	

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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 January 27th, 2007.

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:

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

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Section 15.209: Spurious Emissions (below 30 MHz)

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

No emissions were observed

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 spurious emission observed does not exceed the level of the fundament emission.

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

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

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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.

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.

A fundamental emission level of 43.5 dBuV/m at 10 metres equates to a level of approximately 53.5 dBuV/m at 3 metres.

In order to comply two turns of cable were required around a ferrite core.

Result: Complies with a 0.0 dB margin at 67.800 MHz (Vertical).

Measurement uncertainty with a confidence interval of 95% is:

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

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Spurious Emissions

Frequency MHz	Level		Recheck dBuV/m	Limit dBuV/m	Margin dB	Result	Worst Case Antenna
	Vertical dBuV/m	Hort dBuV/m					
40.680	39.1			40.0	0.9	Uncert	Vertical
54.242	36.9			40.0	3.1	Uncert	Vertical
67.800	40.0			40.0	0.0	Uncert	Vertical
81.360	30.4			40.0	9.6	Pass	Vertical
94.920	30.0			43.5	13.5	Pass	Vertical
108.480	38.7			43.5	4.8	Pass	Vertical
122.040	36.4			43.5	7.1	Pass	Vertical
135.600	36.0	28.8		43.5	7.5	Pass	Vertical
149.160	36.5	29.2		43.5	7.0	Pass	Vertical
162.720	38.0	32.0		43.5	5.5	Pass	Vertical
176.280	33.0			43.5	10.5	Pass	Vertical
189.840	32.5	30.0		43.5	11.0	Pass	Vertical
203.400	32.8			43.5	10.7	Pass	Vertical
216.970	33.6	28.6		46.0	12.4	Pass	Vertical
230.530	34.6			46.0	11.4	Pass	Vertical
244.090	32.0			46.0	14.0	Pass	Vertical
257.650	36.6			46.0	9.4	Pass	Vertical
284.770	36.0	30.5		46.0	10.0	Pass	Vertical
298.330	32.2			46.0	13.8	Pass	Vertical
311.892	39.5	34.4		46.0	6.5	Pass	Vertical
352.560		30.8		46.0	15.2	Pass	Horizontal
339.015	36.3	35.3		46.0	9.7	Pass	Vertical
366.135	32.0	30.4		46.0	14.0	Pass	Vertical
379.690	34.3	28.8		46.0	11.7	Pass	Vertical
393.257	40.3	32.8		46.0	5.7	Pass	Vertical
406.815	38.7	30.2		46.0	7.3	Pass	Vertical
420.375	36.4			46.0	9.6	Pass	Vertical

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Section 15.225 Operation in the band 13.110 – 14.010 MHz:

Section 15.225 (a)

The fundamental emission was observed to be operating on 13.560 MHz

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Voltage Vac	Result
13.561	43.5	104.0	60.5	93.7	Pass
13.561	43.5	104.0	60.5	110.0	Pass
13.561	43.5	104.0	60.5	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%.

No variation in field strength was observed.

Result: Complies with a 60.5 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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Section 15.225 (b), (c), (d)

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 and the emission level at 13.560 MHz was observed to be 43.5 dBuV/m.

The fundamental emission peak has therefore been placed 60.5 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.

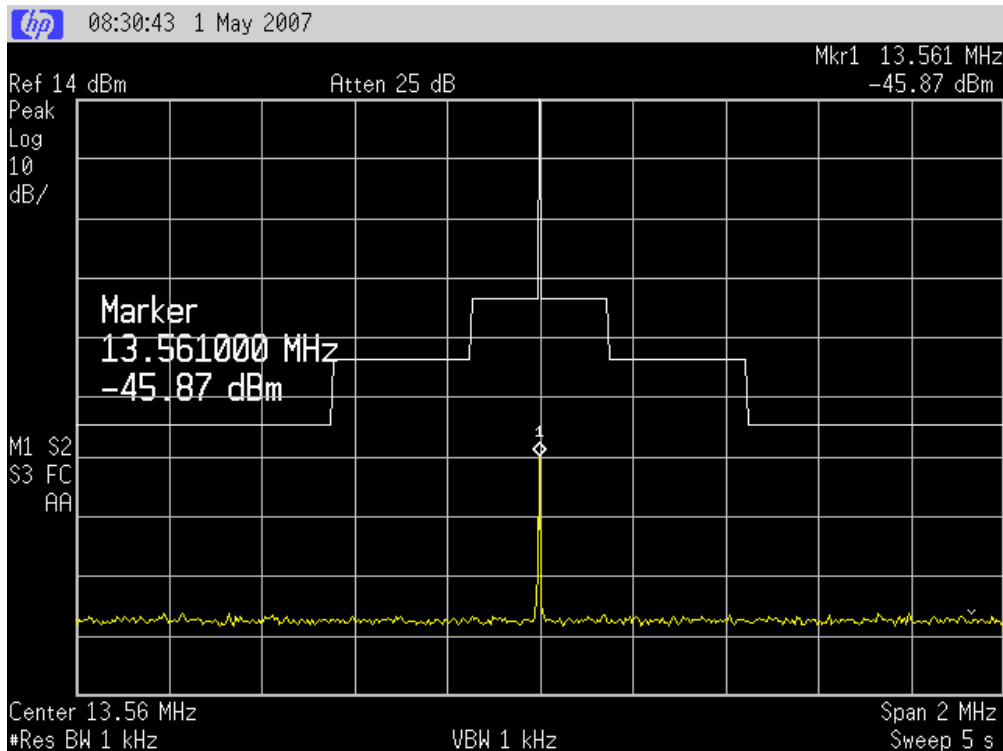
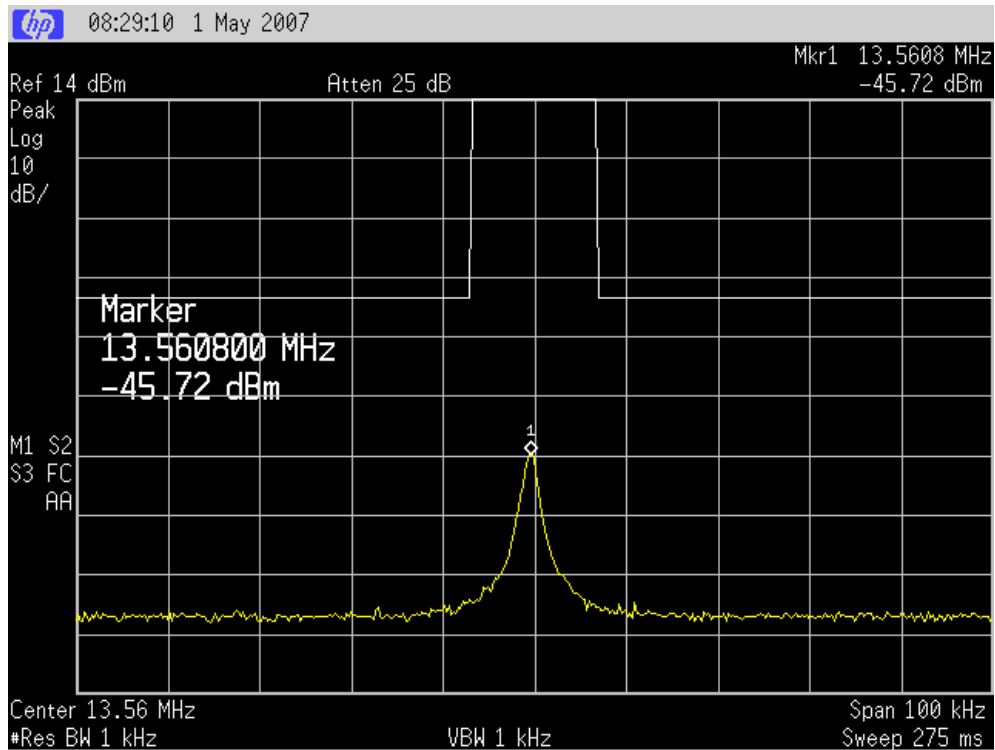
Measurement uncertainty with a confidence interval of 95% is:

- Frequency ± 50 Hz
- Amplitude ± 1.0 dB

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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.

Measurements were made using a spectrum analyser with a span of 10 kHz and a resolution bandwidth of 100 Hz.

Temp (degrees)	Voltage 85%	Voltage Normal	Voltage 115%
-20.0	13.560 730	13.560 730	13.560 730
-10.0	13.560 780	13.560 780	13.560 780
0.0	13.560 750	13.560 750	13.560 750
+10.0	13.560 750	13.560 750	13.560 750
+20.0	13.560 680	13.560 680	13.560 680
+30.0	13.560 700	13.560 700	13.560 700
+40.0	13.560 700	13.560 700	13.560 700
+50.0	13.560 680	13.560 680	13.560 680

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Frequency \pm 50 Hz

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7. 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
Biconical Antenna	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2009
Receiver	R & S	ESCS 30	847124/020	E1595	21 Dec 2007
Receiver	R & S	ESHS 10	828404/005	RFS 3728	11 July 2007
Log Periodic	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2009
Loop Antenna	EMCO	6502	9311-2801	A-231	11 July 2007
Mains Network	R & S	ESH2-Z5	881362/034	3628	18 June 2007
Variac	General Radio	1592	-	RFS 3690	Not applicable
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	Not applicable
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2009

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 January 27th, 2007.

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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9. PHOTOGRAPH (S)



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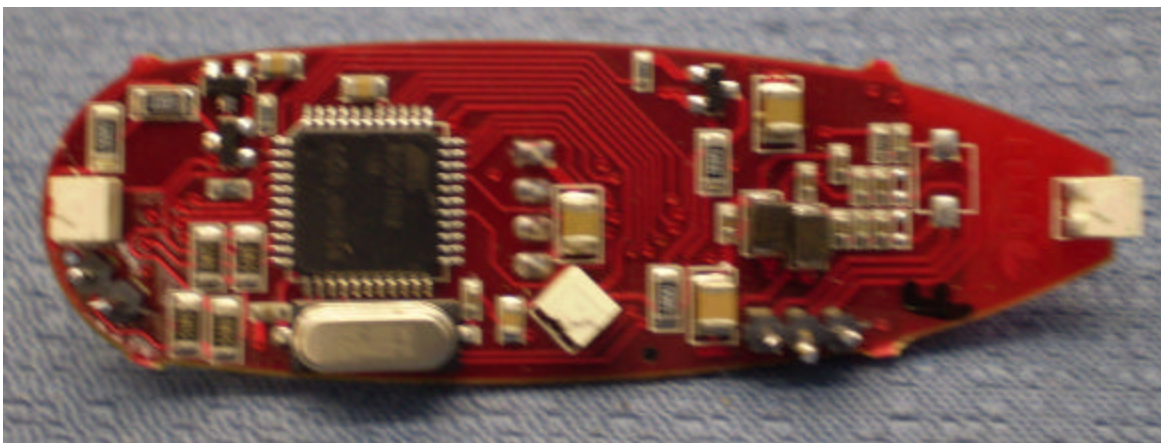
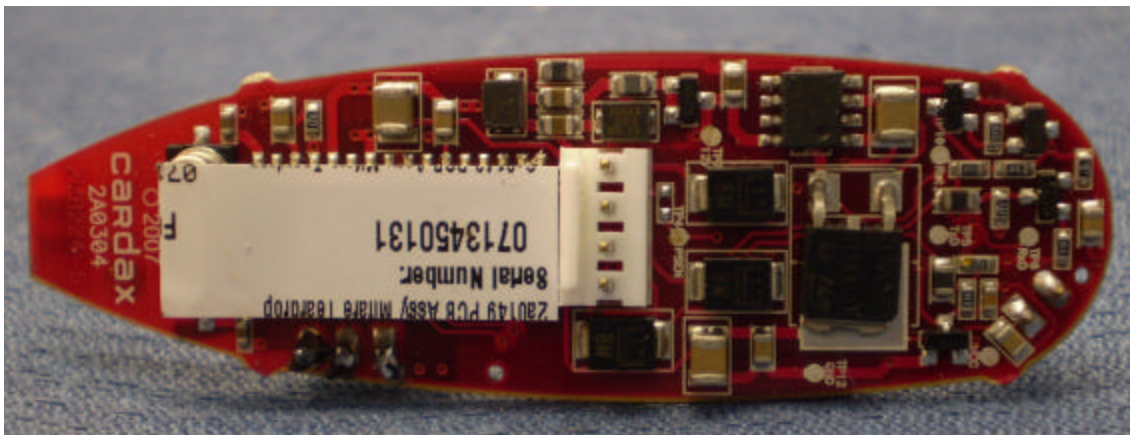
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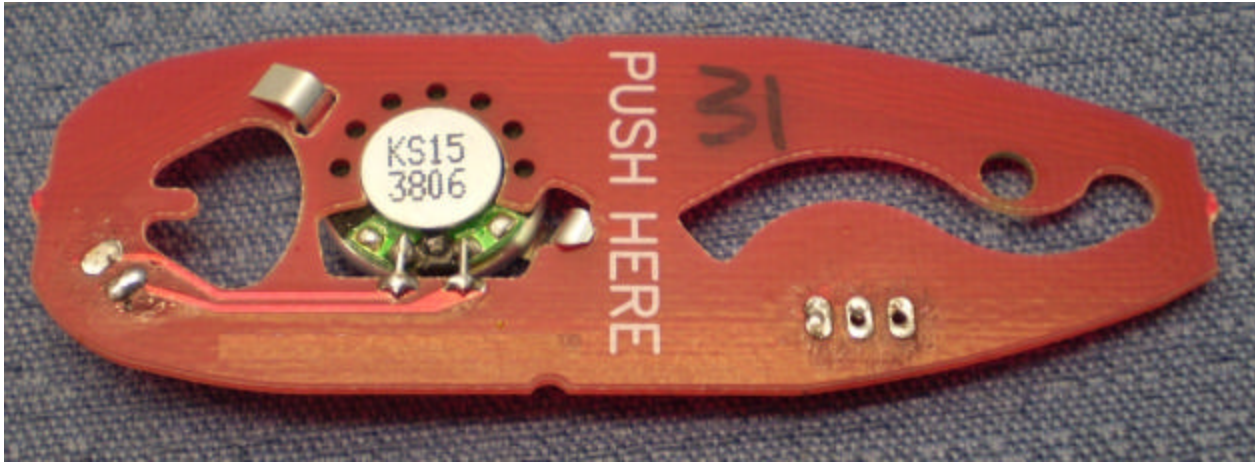
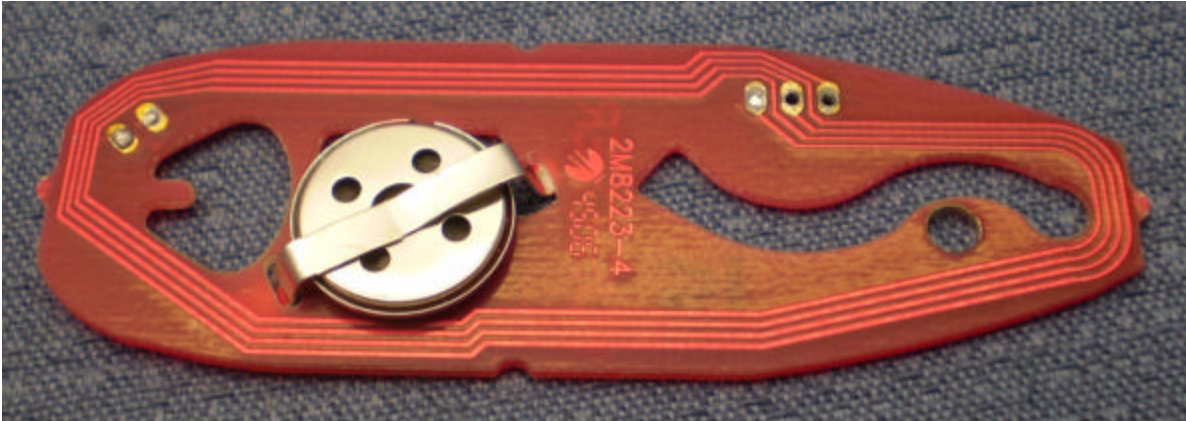
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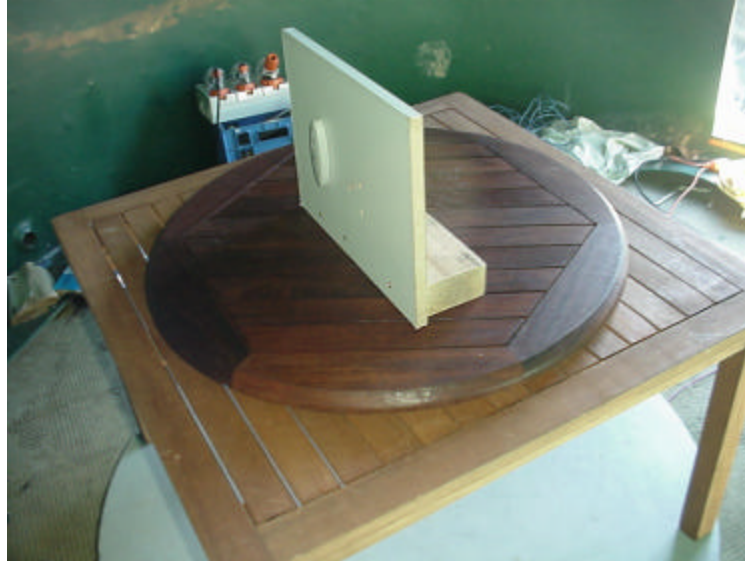


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Radiated emissions test set up



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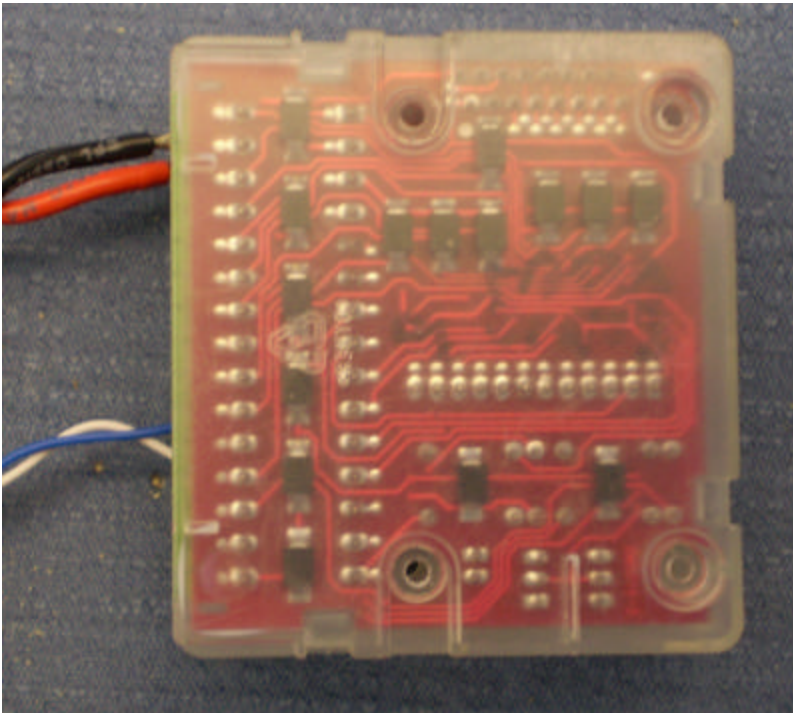
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Ancillary Equipment



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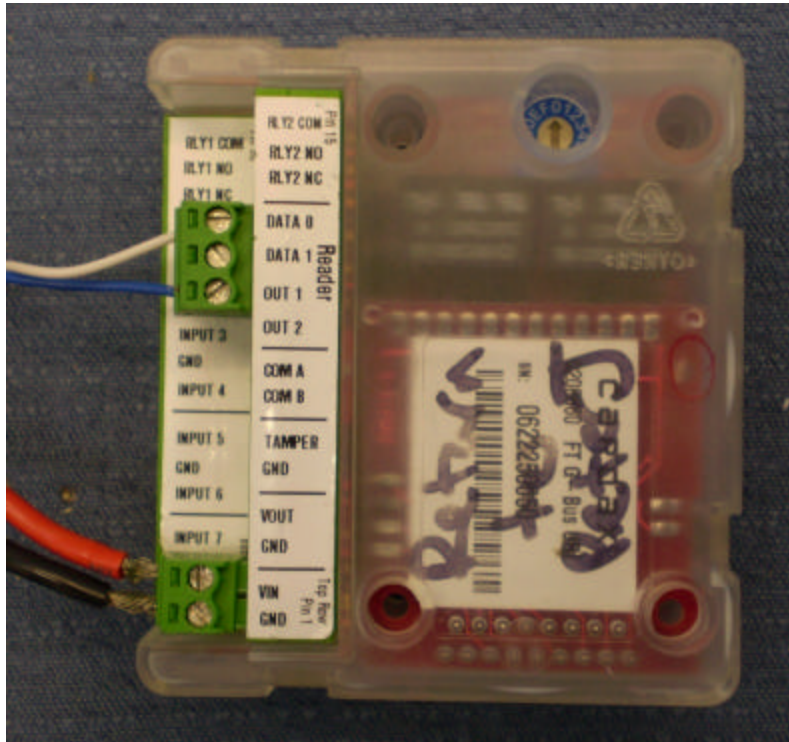
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