

EMC Technologies (NZ) Ltd

Test Report No 40333.1c
Report date: 15th September 2004

TEST REPORT

Cardax Mifare Tear Drop Proximity Card Reader

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

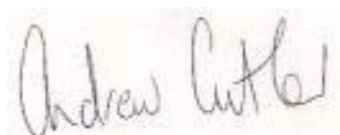
Subpart C – Intentional Radiators

for

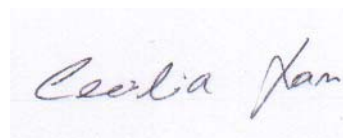
Gallagher Group Ltd

This Test Report is issued with the authority of:

Prepared By:



Andrew Cutler - General Manager



Cecilia Lam - Office Administrator



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1. STATEMENT OF COMPLIANCE

The **Cardax Mifare Tear Drop Proximity 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 13.561 MHz
15.207	Conducted limits	Complies with a 0.53 dB margin at 13.561 MHz (Quasi Peak).
15.209	Radiated emission limits	Complies with a 0.7 dB margin at 176.290 MHz.
15.225 a	Fundamental emission	Complies with a 60.3 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 Tear Drop 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.

This report replaced report 40333.1b 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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5. DESCRIPTION OF TEST SAMPLE

Brand Name	Cardax
Model Number	Mifare Tear Drop Card Reader
Product	Proximity Card Reader
Manufacturer	Gallagher Group Ltd
Country of Origin	New Zealand
Serial Number	0435461117

Ancillary Equipment:

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

Cardax 190200 Univeral Reader Interface. Serial number #19841.

Photographs of this equipment are attached.

The following changes have been made to the device:

The external ferrite choke that previously needed to be fitted to the supply cable to the transmitter is no longer required and has been removed.

In order to comply with the conducted emission requirements a software modification has been made to the device whereby the transmitter duty cycle has been reduced from 100% to 5% which the client advises causes no resulting loss of performance.

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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 - 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.

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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.

Testing has been carried out with the antenna attached to the device with the transmitter transmitting continuously.

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 with a combined plot being provided.

Measurement uncertainty with a confidence interval of 95% is:

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

Result: Complies with a 0.53 dB margin at 13.560895 MHz when measurements are made in quasi peak.

Measurement falls within the window of uncertainty for this test method.

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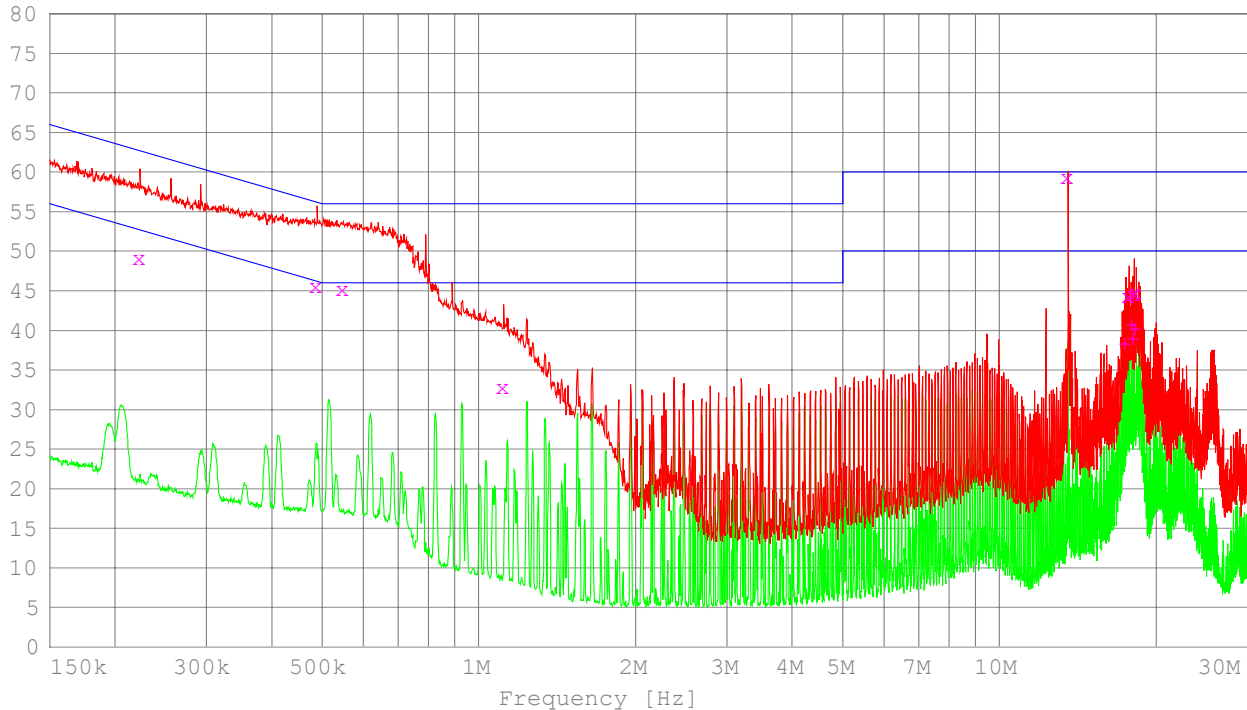
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Conducted Emissions Testing

Comments: Device tested at 110V AC when transmitting continuously with the antenna connected.

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
0.223684	49.25	62.68	13.43		N	
0.489533	45.70	56.18	10.48		N	
0.549680	45.28	56.00	10.72		N	
1.117253	32.94	56.00	23.06		N	
13.560895	59.47	60.00	0.53		L1	
17.744150	44.42	60.00	15.58		L1	
18.156787	44.61	60.00	15.39		L1	
18.357513	44.92	60.00	15.08		L1	

Average Measurements

Frequency MHz	Level dB μ V	Limit dB μ V	Margin dB	Exceed	Phase	Rechecks dB μ V
17.532598	38.32	50.00	11.68		L1	
18.048226	40.73	50.00	9.27		L1	
18.156787	38.96	50.00	11.04		L1	
18.357513	40.16	50.00	9.84		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 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)

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Section 15.209: Spurious Emissions (below 30 MHz)

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Result
27.120	5.0	49.5	44.5	Pass

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

Measurements were made while the device was being powered using a 110 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 a 44.5 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

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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.

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 0.7 dB margin at 176.290 MHz (Vertical).

Measurement falls within the window of uncertainty for this test method.

Measurement uncertainty with a confidence interval of 95% is:

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

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Frequency MHz	Level		Limit dBuV/m	Margin dB	Result	Worst Case Antenna
	Vertical dBuV/m	Hort dBuV/m				
32.000	24.8		40.0	15.2	Pass	Vertical
36.000	22.5		40.0	17.5	Pass	Vertical
38.000	18.7		40.0	21.3	Pass	Vertical
40.000	25.9		40.0	14.1	Pass	Vertical
40.680	37.9		40.0	2.1	Uncert	Vertical
42.000	21.5		40.0	18.5	Pass	Vertical
44.000	23.2		40.0	16.8	Pass	Vertical
46.070	21.1		40.0	18.9	Pass	Vertical
54.240	32.1		40.0	7.9	Pass	Vertical
64.000	21.8		40.0	18.2	Pass	Vertical
64.510	19.8		40.0	20.2	Pass	Vertical
67.800	31.5		40.0	8.5	Pass	Vertical
72.000	20.6		40.0	19.4	Pass	Vertical
80.010	27.3		40.0	12.7	Pass	Vertical
81.360	32.4	15.1	40.0	7.6	Pass	Vertical
84.000	29.4		40.0	10.6	Pass	Vertical
94.925	25.5		43.5	18.0	Pass	Vertical
108.000	25.8		43.5	17.7	Pass	Vertical
116.000	23.2		43.5	20.3	Pass	Vertical
120.010	24.1		43.5	19.4	Pass	Vertical
122.050	35.1		43.5	8.4	Pass	Vertical
124.010	21.9		43.5	21.6	Pass	Vertical
128.010	20.1		43.5	23.4	Pass	Vertical
132.010	25.7		43.5	17.8	Pass	Vertical
135.610	30.8		43.5	12.7	Pass	Vertical
140.010	23.2		43.5	20.3	Pass	Vertical
162.730	33.5	25.6	43.5	10.0	Pass	Vertical
176.290	39.3	30.3	40.0	0.7	Uncert	Vertical
189.850	31.0	29.1	43.5	12.5	Pass	Vertical
216.970	28.5	24.1	46.0	17.5	Pass	Vertical
230.530	32.3	25.3	46.0	13.7	Pass	Vertical
284.770	33.2	21.5	46.0	12.8	Pass	Vertical
298.330	29.8	25.5	46.0	16.2	Pass	Vertical
339.000	34.4		46.0	11.6	Pass	Vertical
352.500	23.0		46.0	23.0	Pass	Vertical
393.250	34.1		46.0	11.9	Pass	Vertical
447.500	35.3		46.0	10.7	Pass	Vertical
610.250	32.6		46.0	13.4	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 were observed to be operating on 13.561 MHz

MHz	Level dBuV/m	Limit dBuV/m	Margin dB	Voltage Vac	Result
13.561	43.7	104.0	60.3	93.7	Pass
13.561	43.7	104.0	60.3	110.0	Pass
13.561	43.7	104.0	60.3	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 has 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 was observed.

Result: Complies with a 46.4 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)

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 fundamental emission peak was originally placed 46.4 dB down on the reference level. With the change in duty cycle the emission peak would now be placed 60.3 dB down.

The emission spectrum has been rechecked and found to be identical to that that was previous measured so the previous spectrum plots have been retained.

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

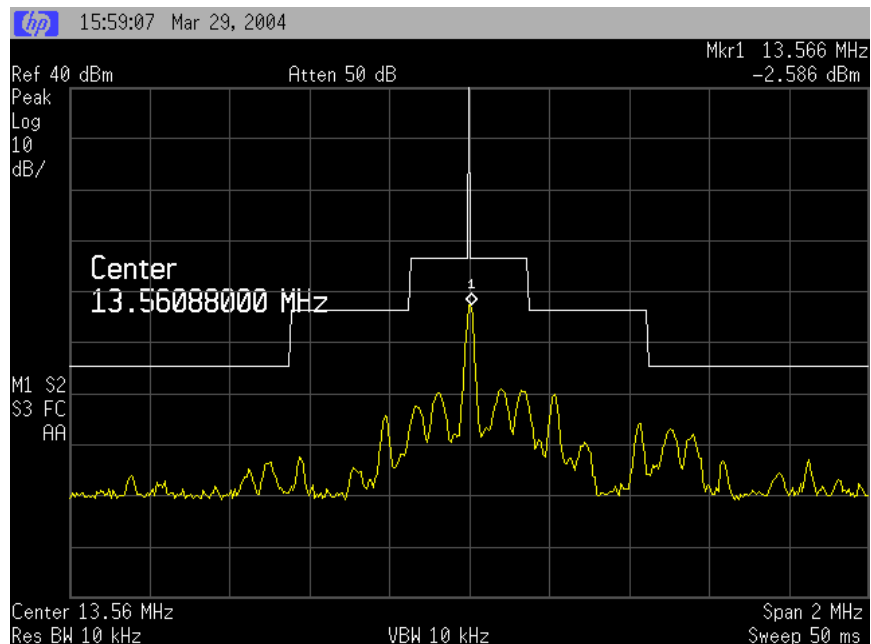
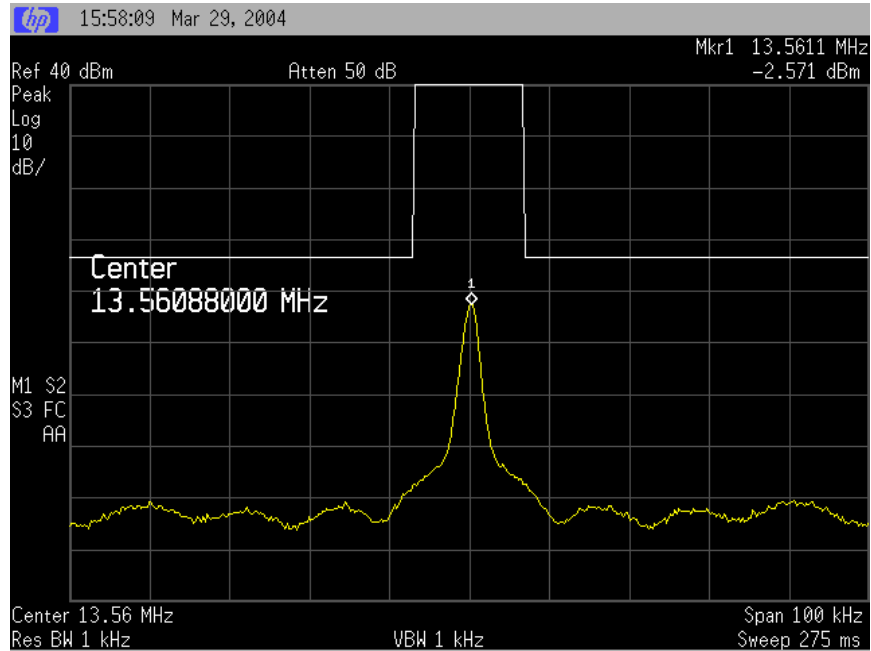
uncertainty with a confidence interval of 95% is:

- 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.

The previous measurements were reconfirmed and are identical.

Temp (degrees)	Voltage 85%	Voltage Normal	Voltage 115%
-20.0		13.560 750	
-10.0		13.560 880	
0.0		13.560 880	
+10.0		13.560 880	
+20.0	13.560 880	13.560 880	13.560 880
+30.0		13.560 880	
+40.0		13.560 880	
+50.0		13.561 010	

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	Calibration 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	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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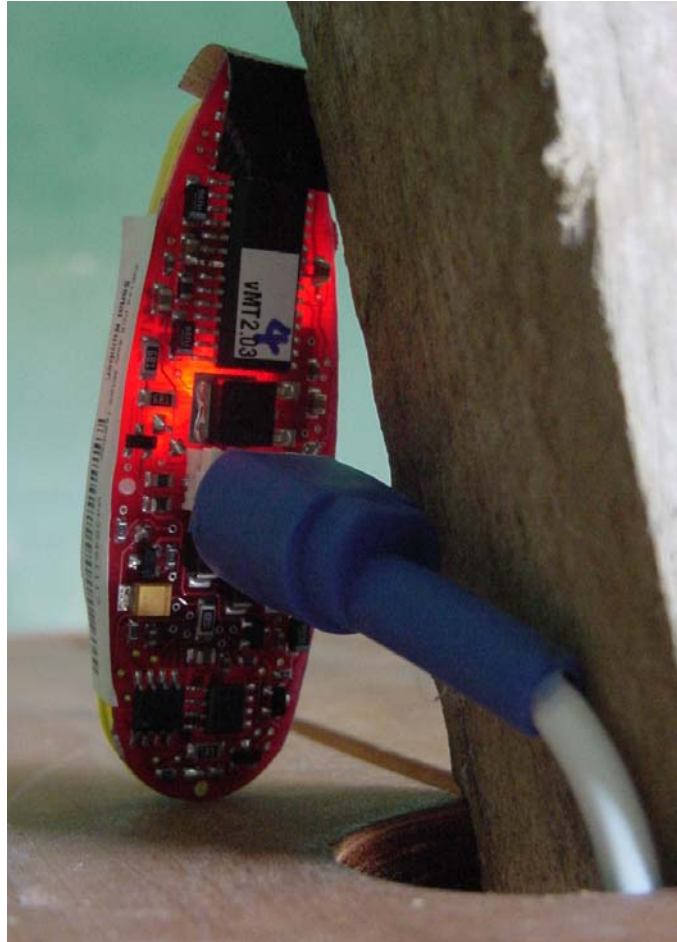
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9. PHOTOGRAPH (S)

External Views



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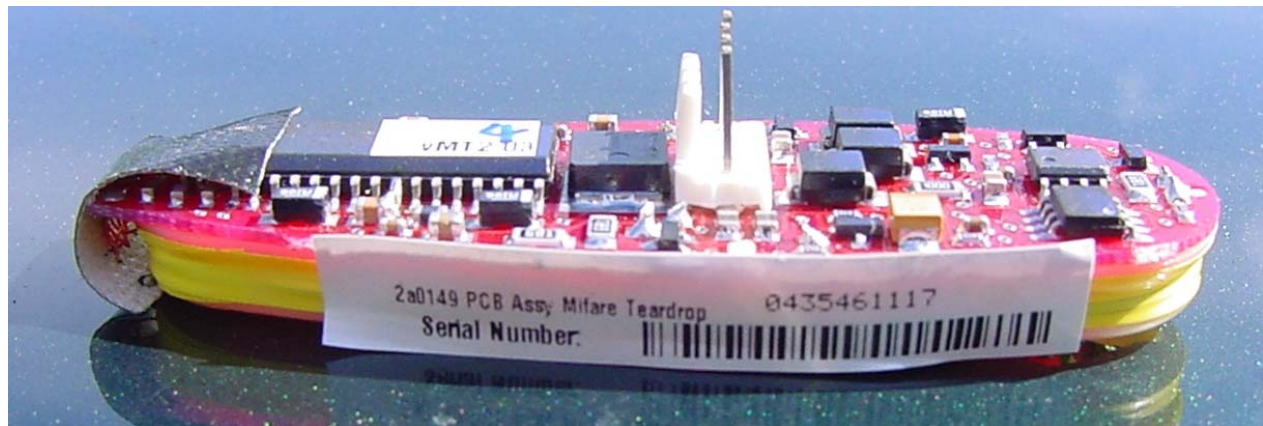
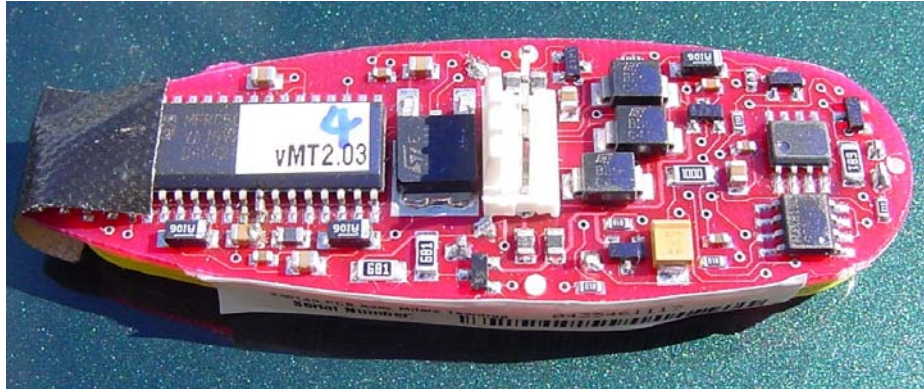
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Internal Photographs



Label



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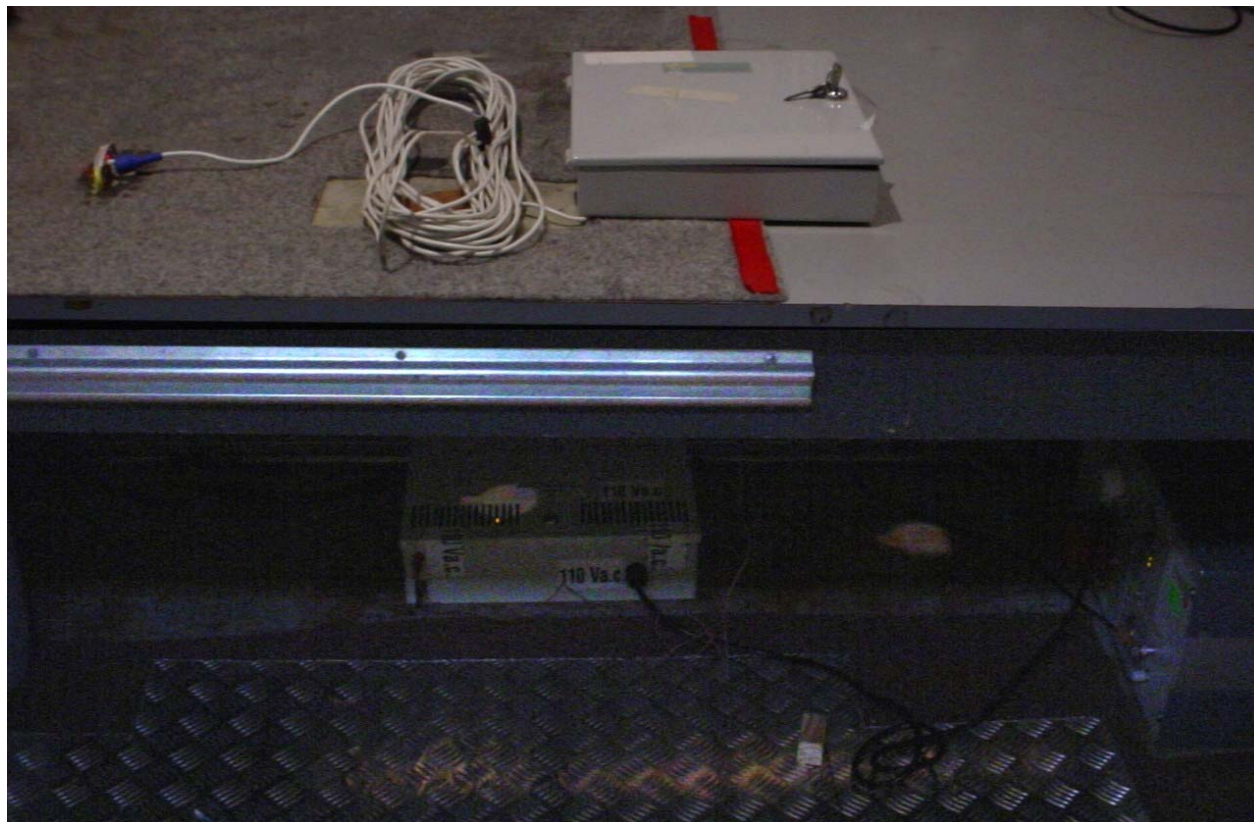
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Conducted emissions Test Set Up



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Radiated Emissions Test Set Up



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Ancillary equipment set up



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