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TEST REPORT

ICT PRX-Tsec Multi Technology RFID Reader

tested to

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

Section 15.225
Operation within the band 13.110 -14.010 MHz

for

Integrated Control Technology Ltd

This Test Report is issued with the authority of:

Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Table of Contents

1. STATEMENT OF COMPLIANCE

The **ICT PRX-Tsec Multi Technology RFID Reader** complies with FCC Part 15 Subpart C Section 15.225 as an Intentional Radiator when the methods as described in ANSI C63.4 - 2003 are applied.

2. RESULTS SUMMARY

The results from testing carried out in November 2013 and February 2014 are detailed in the following table:

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification required.
15.203	Antenna requirement	Complies. Antennas internal to the device.
15.204	External PA and antenna modifications	Not applicable. No external devices.
15.205	Restricted bands of operation	Complies. Device transmits on 125 kHz and 13.562 MHz.
15.207	Conducted limits	Complies.
15.209	Radiated emission limits - Emissions < 30 MHz	Complies.
15.209	Radiated emission limits – Emissions > 30 MHz	Complies.
15.225	Radiated emission limits - Fundamental	Complies.
15.225	Frequency stability	Complies.

3. INTRODUCTION

This report describes the tests and measurements performed 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	Integrated Control Technology Ltd
Address	11 Canaveral Drive, Albany
City	Auckland 0632.
Country	New Zealand
Contact	Mr Stephen Hayes

5. DESCRIPTION OF TEST SAMPLE

Brand Name	ICT
Model Number Tested	PRX - Tsec
Product	Multi Technology RFID Reader
Manufacturer	Integrated Control Technology Ltd
Country of Origin	New Zealand
Serial Number	1B8F5F35
FCC ID	UAUPRX-TSEC

The device tested is a RFID card reader that can be used with many different types of card reader protocols.

It operates on both 125 kHz and 13.560 MHz.

6. SETUPS AND PROCEDURES

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

The device has internal antennas for both the 125 kHz and the 13.560 MHz transmitters.

Result: Complies.

Section 15.204: External radio frequency power amplifiers and antenna modifications

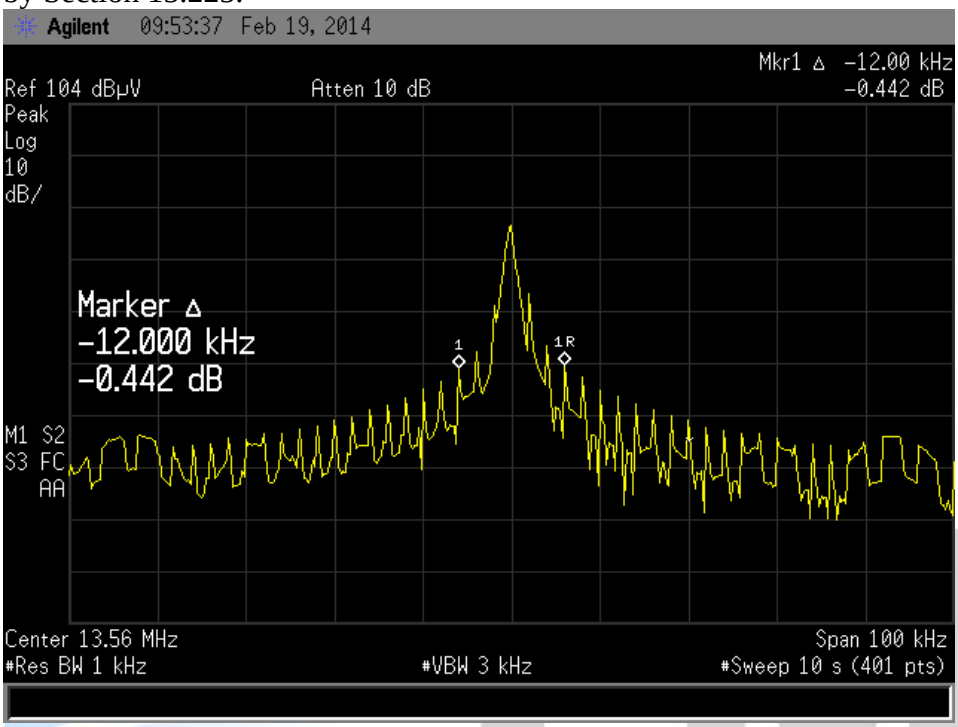
It is not possible to attach an external power amplifier to this transmitter.

Result: Complies.

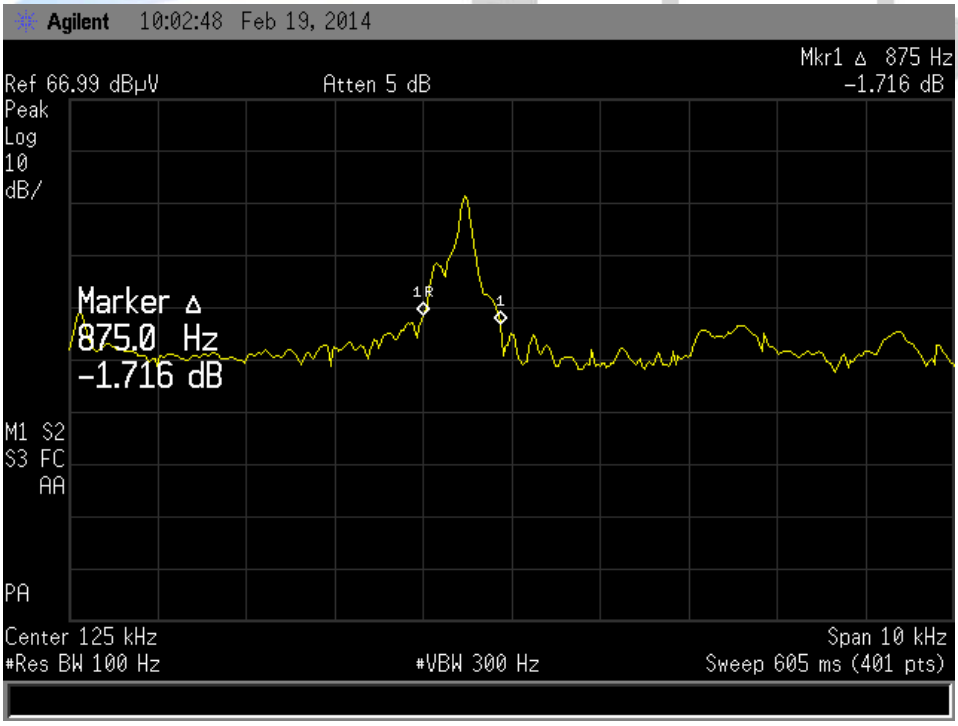
Section 15.205: Restricted bands of operation

The device transmits on 125 kHz and 13.560 MHz.

13.560 MHz transmissions would fall into the 13.110 – 14.010 MHz band that is covered by Section 15.225.



125 kHz transmissions would therefore fall between the restricted bands of 90 – 110 kHz and 495 – 505 kHz



Result: Complies.

Section 15.207: Conducted emissions testing

Conducted Emissions testing was carried out over the frequency range of 150 kHz to 30 MHz which was carried out at the laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room

As it is possible for this device to be directly or indirectly connected to the Public AC mains supply testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz which supplied 12 Vdc to the device in order to test it.

The device operates on 125 kHz and 13.560 MHz.

Testing was carried out with both transmitters operating with their standard antennas attached and when the antennas were removed and replaced with a dummy loads.

The device is deemed to comply providing it complies when the test is carried out with the dummy loads attached and the overall emission signature for the product remains similar with no additional emissions being detected.

This is the case with this device.

The device was placed on top of the emissions table, which is 1 m x 1.5 m, 80 cm above the screened room floor which acts as the horizontal ground plane.

In addition the device was positioned 40 cm 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 80 cm from the artificial mains network.

The Class B limits have been applied.

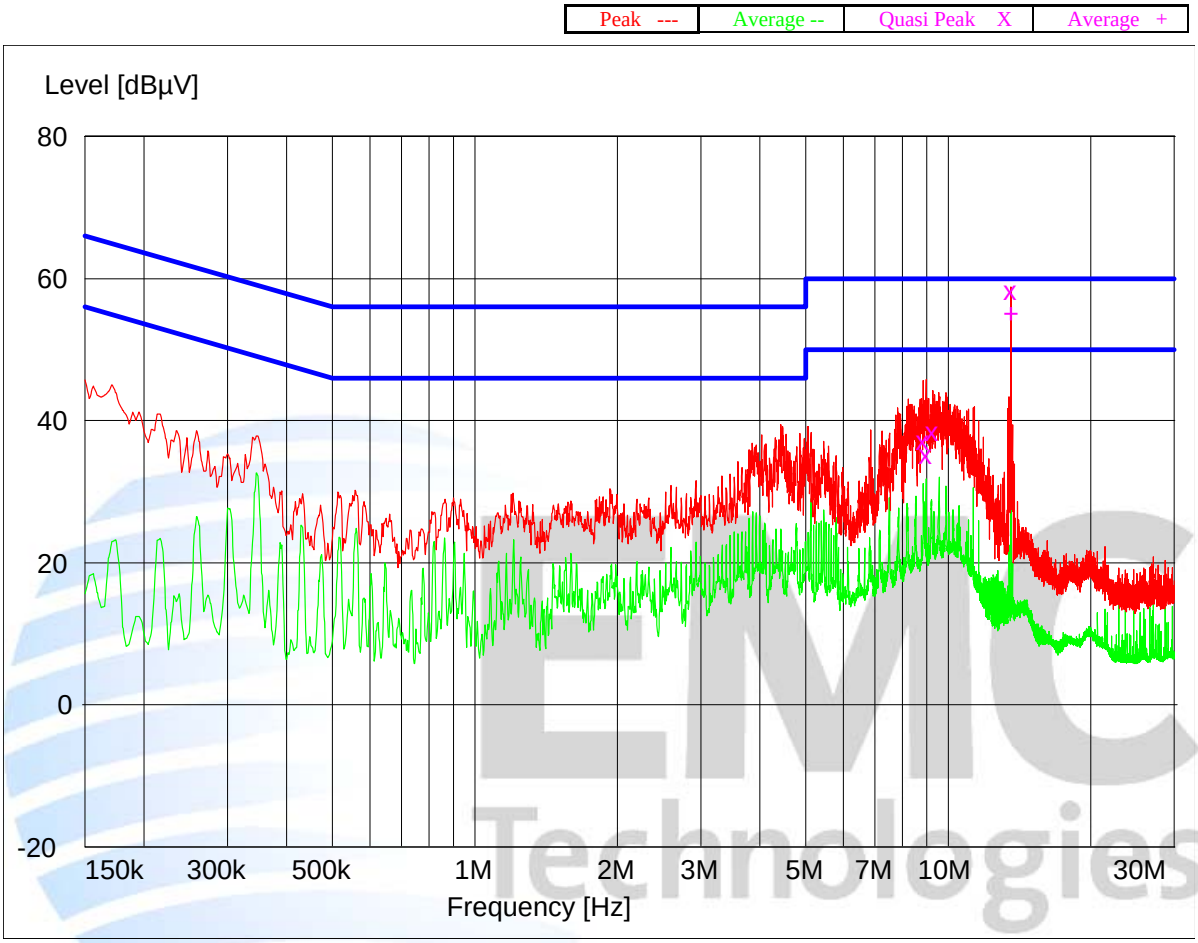
The supplied plot is combined plot showing the worst case quasi peak and average results of both the phase and neutral lines to the representative AC power supply.

Quasi peak and average detectors have been used with resolution bandwidths of 9 kHz.

Measurement uncertainty with a confidence interval of 95% is:
- AC Mains port (0.15-30 MHz) ± 2.8 dB

Conducted Emissions – AC Input Power Port

Setup:	Device tested when powered at 12 Vdc using a representative 120 Vac / 60 Hz AC power supply while transmitting continuously of 125 kHz and 13.560 MHz with a card in the field that was beeping continuously. Antennas operating normally.



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
8.853500	37.20	60.0	22.8	N	
8.966000	35.20	60.0	24.8	N	
9.272000	38.40	60.0	21.6	L1	
13.560500	58.30	60.0	1.7	N	58.1

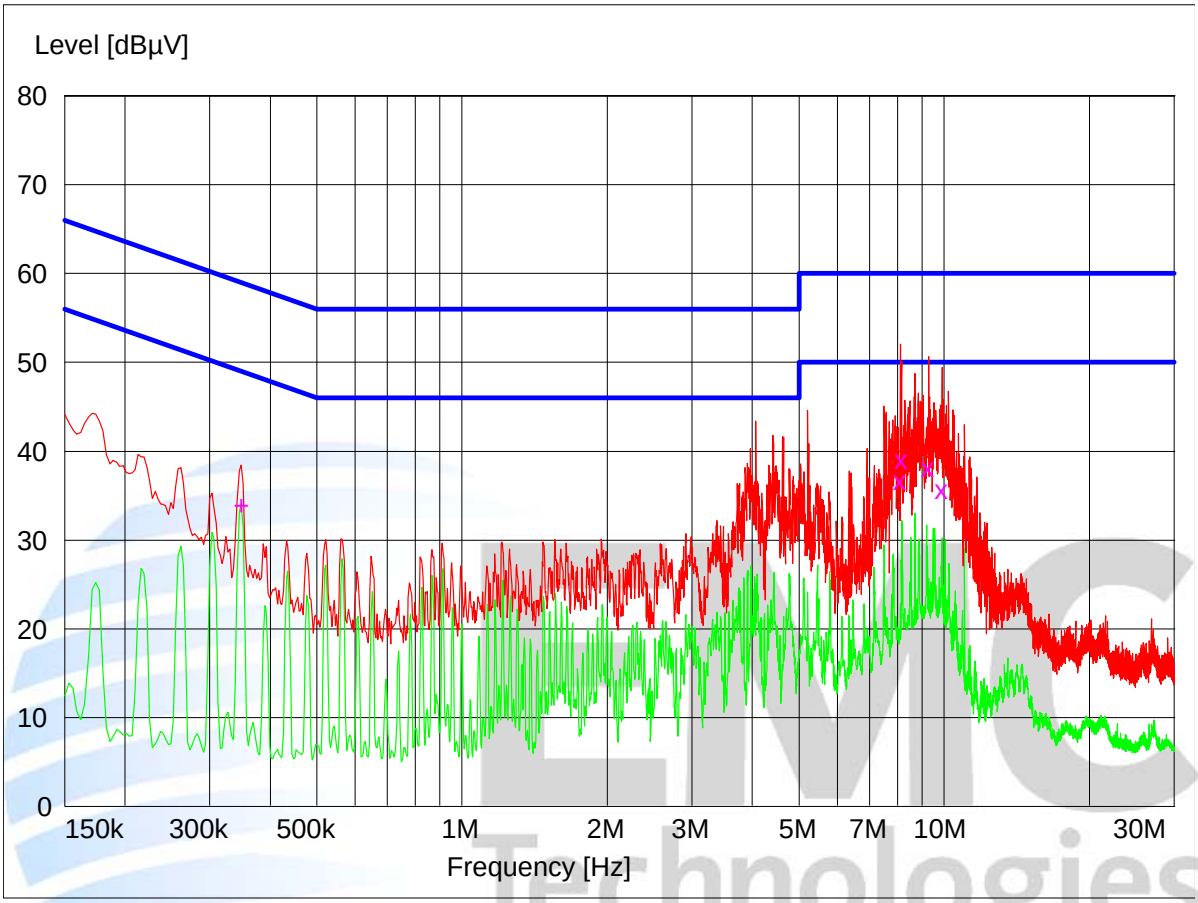
Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
13.560500	55.00	50.0	-5.0	N	58.3

Conducted Emissions – AC Input Power Port

Setup:	Device tested when powered at 120 Vac 60 Hz using a representative ac adaptor. Attached to the device was a laptop computer. Antenna replaced by resistive dummy load.

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



Final Quasi-Peak Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
8.111000	36.70	60.0	23.3	N	
8.178500	39.00	60.0	21.0	N	
9.276500	38.20	60.0	21.8	N	
9.897500	35.70	60.0	24.3	N	

Final Average Measurements

Frequency MHz	Level dBµV	Limit dBµV	Margin dB	Phase	Rechecks dBµV
0.348000	33.90	49.0	15.1	N	

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 10 kHz to 1000 MHz as the highest frequency declared by the client is less than 108 MHz

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 and ANSI C63.4 - 2003.

Testing was carried out using a 12.0 Vdc battery supply.

Initial testing was carried out with the device being placed in the centre of the test table laying flat, standing vertically upright and when laying on an edge.

Final testing was carried out in the worst case orientation which was determined to be when it was standing vertically upright.

Attached to the device was a data interface board that supplied voltage to the device and allowed a serial interface to a laptop computer that was attached to the serial port on this interface board.

The device was transmitting continuously on 125 kHz and 13.560 MHz with correct operation being confirmed periodically by placing various RFID cards in close proximity to the reader.

Correct operations were indicated by a beep.

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.

Below 30 MHz a magnetic loop is used with the centre of the loop being 1 metre above the ground with measurements being made using a quasi peak detector at a distance of 10 metres.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations, where appropriate, using a quasi peak detector at a distance of 3 metres

The emission level was determined in field strength by taking the following into consideration:

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

Result: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 – 2000 MHz) ± 4.1 dB
- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

Section 15.209: 125 kHz Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with an average detector and a peak detector both using a 9 kHz bandwidth

Frequency (kHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Distance (metres)
125.000	54.1	84.7	30.6	Average	10
125.000	70.1	104.7	34.6	Peak	10

Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit as detailed in section 15.31 f (2).

The average limit at 300 m at 125 kHz is 19.2 uV/m or 25.6 dBuV/m and 45.6 dBuV/m in peak.

This gives a limit at 10 m at 125 kHz of 84.7 dBuV/m and 104.7 dBuV/m in peak

Testing was also carried out to determine whether a variation in the supply voltage would cause a significant change in field strength with the 120 Vac supply being varied by +/- 15% between 102 Vac and 138 Vac however no variation was observed as detailed below.

Voltage (Vdc)	Field Strength (dBuV/m)
102.0	54.1
120.0	54.1
138.0	54.1

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

Section 15.209: 125 kHz Spurious Emissions (below 30 MHz)

A receiver with an average detector and a peak detector using a 9 kHz bandwidth was used between 110 – 490 kHz and a quasi peak detector with a 9 kHz bandwidth was used between 490 kHz – 30.0 MHz.

Frequency kHz	Level dBuV/m	Limit dBuV/m	Margin dB	Detector	Comment
250.000	44.0	78.7	-	Average	Noise Floor
250.000	54.0	98.7	-	Peak	Noise Floor
375.000	46.0	75.2	-	Average	Noise Floor
375.000	56.0	95.2	-	Peak	Noise Floor
500.000	43.0	52.7	-	Quasi Peak	Noise Floor
625.000	45.0	50.8	-	Quasi Peak	Ambient
750.000	34.0	49.2	-	Quasi Peak	Noise Floor
875.000	33.0	47.9	-	Quasi Peak	Ambient
1000.000	30.0	46.7	-	Quasi Peak	Noise Floor
1125.000	32.0	45.7	-	Quasi Peak	Noise Floor
1250.000	35.0	44.8	-	Quasi Peak	Ambient
1375.000	26.0	43.9	-	Quasi Peak	Noise Floor
1500.000	28.0	43.2	-	Quasi Peak	Noise Floor
1625.000	24.0	42.5	-	Quasi Peak	Noise Floor
1750.000	24.0	48.6	-	Quasi Peak	Noise Floor
1875.000	22.0	48.6	-	Quasi Peak	Noise Floor

No spurious emissions were detected from the 125 kHz transmitter.

Magnetic loop measurements were made a distance of 10 metres.

At each frequency the measurement antenna was further adjusted to give the highest field strength.

The 300 metre limit between 125 – 490 kHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

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 limit between 110 – 490 kHz was increased by 20 dB when the peak detector was used.

The spurious emissions observed do 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) ± 4.8 dB

Section 15.209: 13.560 MHz transmitter below 30 MHz spurious emission measurements

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
27.120	12.1	48.6	36.5

Testing was carried out when the device was transmitting continuously.

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

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

The 30 metre limit between 1.705 MHz – 30 MHz has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The limit at 27.120 MHz when measured at 30 metres is 30 uV/m or 29.54 dBuV/m.

Therefore the scaled limit at 10 metres will be 48.6 dBuV/m.

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) ± 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.

A receiver with a quasi peak detector with a 120 kHz bandwidth was used between 30 – 1000 MHz and with a peak and average detector with a 1 MHz bandwidth was used between 1000 – 2000 MHz.

The limits as described in Section 15.209 have been applied.

Frequency (MHz)	Vertical (dBµV/m)	Horizontal (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	BW
40.680			40.0	40.0	Quasi Peak	120 kHz
51.851	26.5		40.0	13.5	Quasi Peak	120 kHz
54.250	25.9		40.0	14.1	Quasi Peak	120 kHz
67.800			40.0	40.0	Quasi Peak	120 kHz
81.360	20.9	24.8	40.0	15.2	Quasi Peak	120 kHz
94.920		30.4	43.5	13.1	Quasi Peak	120 kHz
108.480	26.6	32.9	43.5	10.6	Quasi Peak	120 kHz
122.040			43.5	43.5	Quasi Peak	120 kHz
135.600	25.1		43.5	18.4	Quasi Peak	120 kHz
149.160	25.8		43.5	17.7	Quasi Peak	120 kHz
162.720	26.6	30.5	43.5	13.0	Quasi Peak	120 kHz
176.280	22.6	25.7	43.5	17.8	Quasi Peak	120 kHz
189.940	25.2		43.5	18.3	Quasi Peak	120 kHz
203.400	22.2		43.5	21.3	Quasi Peak	120 kHz
216.960	28.1	29.3	46.0	16.7	Quasi Peak	120 kHz
244.000	24.5		46.0	21.5	Quasi Peak	120 kHz
271.200	24.6		46.0	21.4	Quasi Peak	120 kHz
298.320	26.8	33.8	46.0	12.2	Quasi Peak	120 kHz
311.952	29.1	38.3	46.0	7.7	Quasi Peak	120 kHz
325.511	32.5	41.4	46.0	4.6	Quasi Peak	120 kHz
339.070		33.2	46.0	12.8	Quasi Peak	120 kHz
352.629	34.1	42.2	46.0	3.8	Quasi Peak	120 kHz
366.120	28.5	31.2	46.0	14.8	Quasi Peak	120 kHz
379.747		34.5	46.0	11.5	Quasi Peak	120 kHz
542.491	35.2	37.4	46.0	8.6	Quasi Peak	120 kHz
556.050	32.9	34.5	46.0	11.5	Quasi Peak	120 kHz
596.731	38.6	40.4	46.0	5.6	Quasi Peak	120 kHz
596.761	35.9	39.3	46.0	6.7	Quasi Peak	120 kHz
610.228		33.6	46.0	12.4	Quasi Peak	120 kHz
624.010		35.8	46.0	10.2	Quasi Peak	120 kHz

All other emissions observed had a margin to the limit that exceeded 20 dB when measurements were attempted over the range of 30 – 1000 MHz using both vertical and horizontal polarisations.

Result: Complies.
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 MHz – 1000 MHz) ± 4.1 dB

Section 15.225: Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with a quasi peak detector using a 9 kHz bandwidth.

Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit, as detailed in section 15.31 f (2).

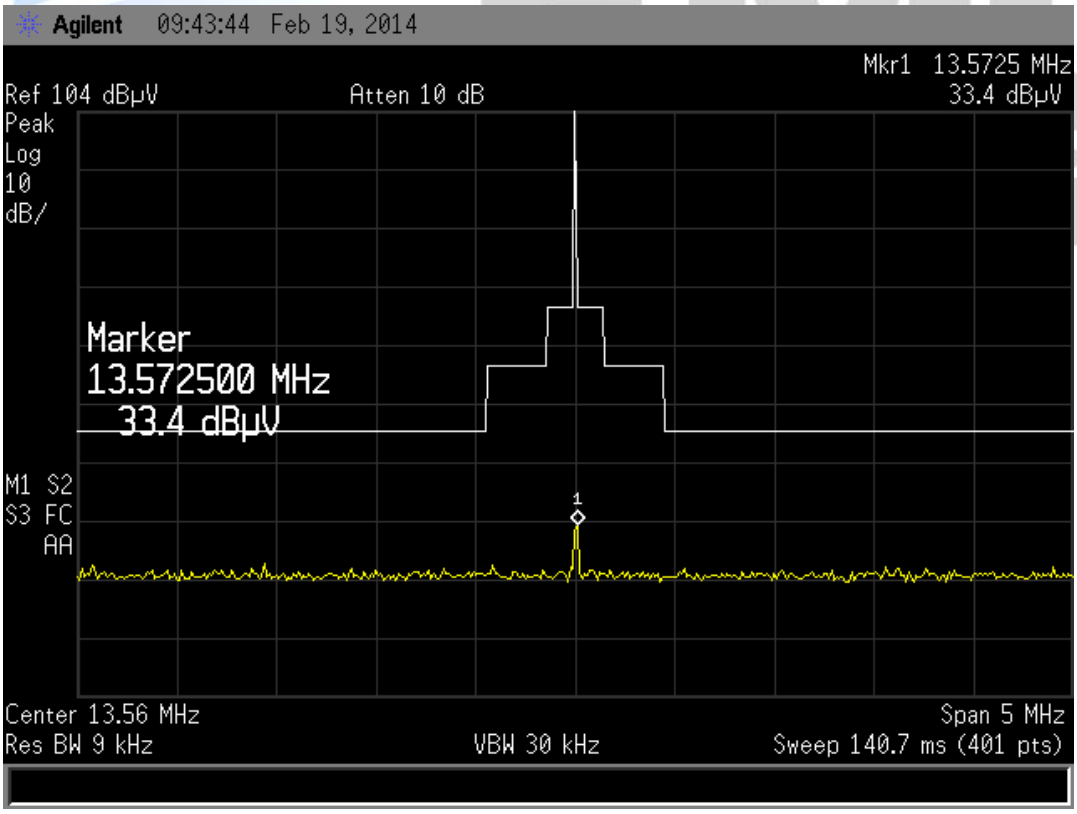
The limit at 30 m at 13.560 MHz is 15,848 uV/m or 84.0 dBuV/m.

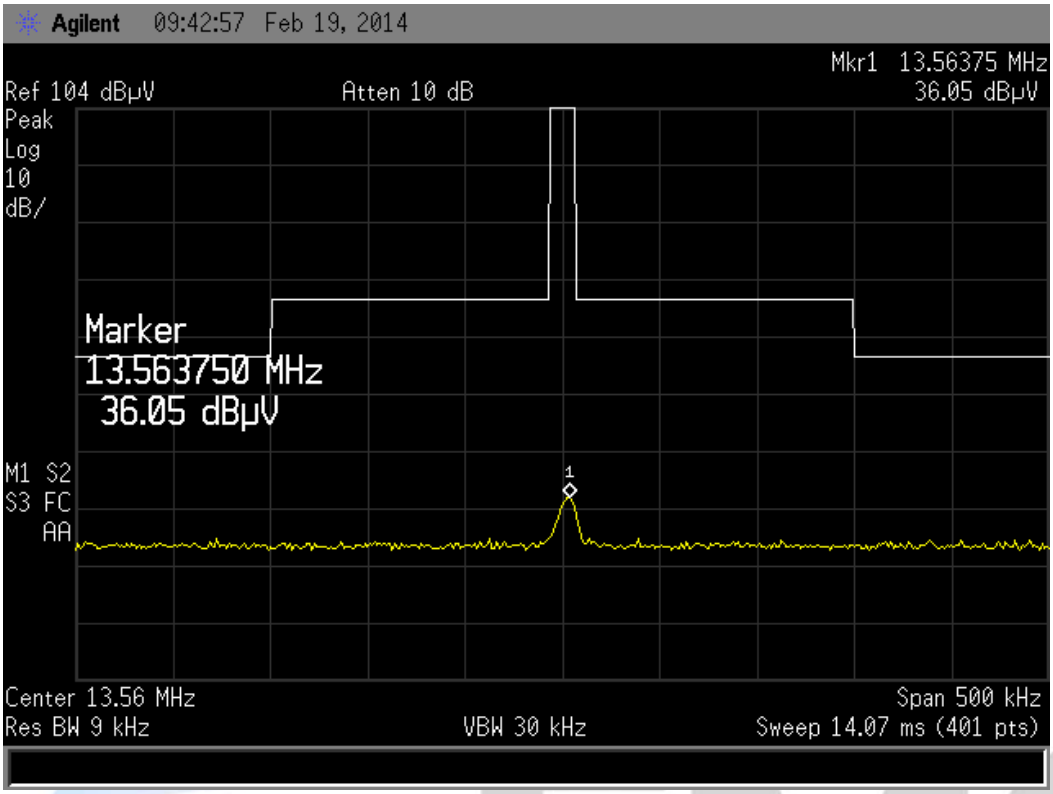
Applying the extrapolation factor of 40 dB/ per decade, the limit is 103.1 dBuV/m.

Testing was carried out when the device was transmitting continuously when the 12 Vdc supply to the device was varied by +/- 15%.

Voltage (Vdc)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
12.0	13.560	34.1	103.1	69.0
13.8	13.560	34.1	103.1	69.0
10.2	13.560	34.1	103.1	69.0

Representative spectrum analyser plots show the carrier and modulation peaks within +/- 500 kHz and +/- 5 MHz of the carrier.





Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

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

Section 15.225: Frequency tolerance:

The frequency tolerance of the carrier is required to be +/- 0.01% of operating frequency when the temperature is varied between -20 degrees and +50 degrees.

The device operates nominally on 13.562 MHz which gives a frequency tolerance of +/- 1,356.2 Hz.

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50.0	13.562 055	+55
40.0	13.562 055	+55
30.0	13.562 085	+85
20.0	13.562 105	+105
10.0	13.562 142	+142
0.0	13.562 180	+180
-10.0	13.562 237	+237
-20.0	13.562 264	+264

The device normally operates on 12 Vdc.

The DC supply was varied by +/- 15% at an ambient temperature of 20 degrees.

Voltage (Vdc)	Frequency (MHz)	Difference (Hz)
10.2	13.562 100	+275
12.0	13.562 105	+275
13.8	13.562 100	+275

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

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Interval
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	N/a	-
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	N/a	-
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/a	-
AC Supply	APT	7008	4170003	-	N/a	-
Receiver	R & S	ESHS 10	828404/005	3728	21 Nov 2015	1 year
Mains Network	R & S	ESH2-Z5	881362/032	3628	21 Aug 2015	1 year
Receiver	R & S	ESIB-40	100171	R-27-1	21 April 2015	1 year
Spec Analyser	Hewlett Packard	E7405A	US39150142	3771	20 April 2015	1 year
Loop Antenna	EMCO	6502	9003-2485	3798	7 Feb 2015	1 year
VHF Balun	Schwarzbeck	VHA 9103	-	RFS 3603	7 Feb 2015	1 year
Biconical Ant	Schwarzbeck	BBA 9106	-	RFS 3612	7 Feb 2015	1 year
Log Periodic Ant	Schwarzbeck	VUSLP 9111	9111-228	3785	7 Feb 2015	1 year

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 updated in July 2013.

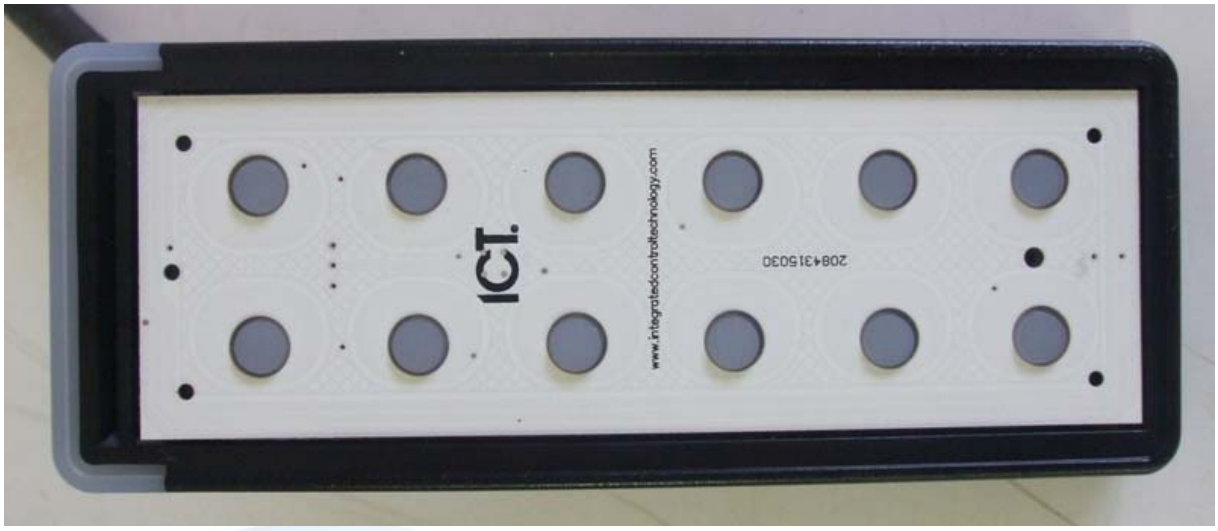
All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

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.

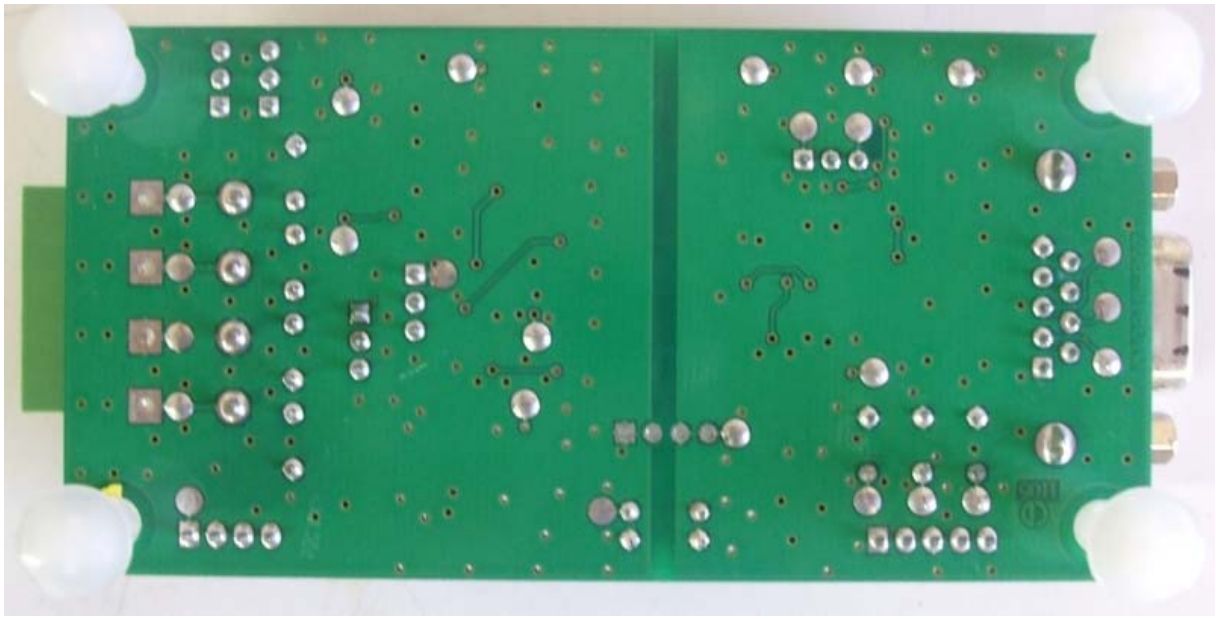
International Accreditation New Zealand has Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies. This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden). Further details can be supplied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

9. PHOTOGRAPHS

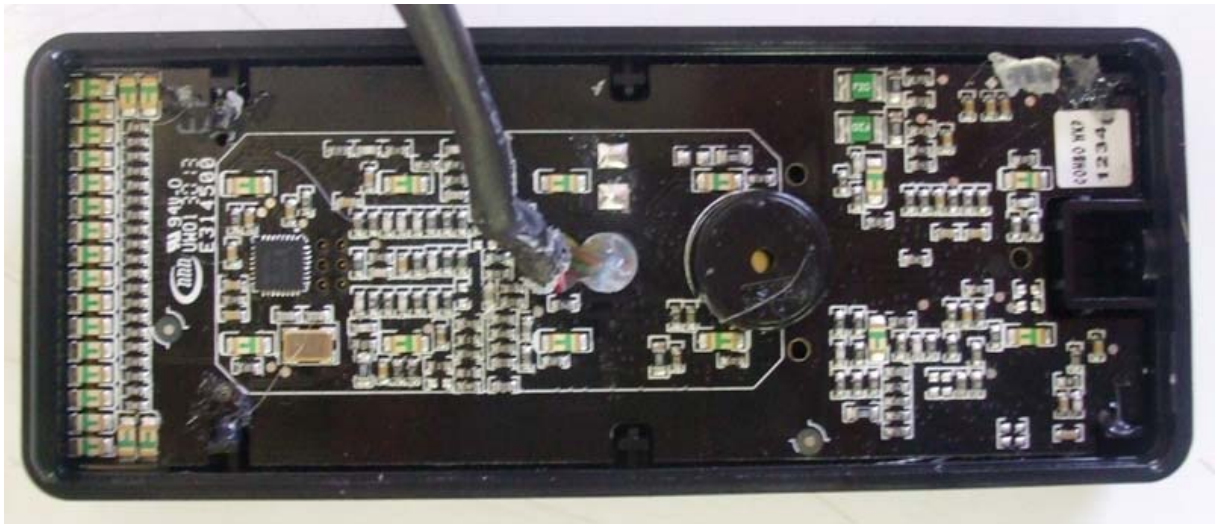
External View Device Under Test

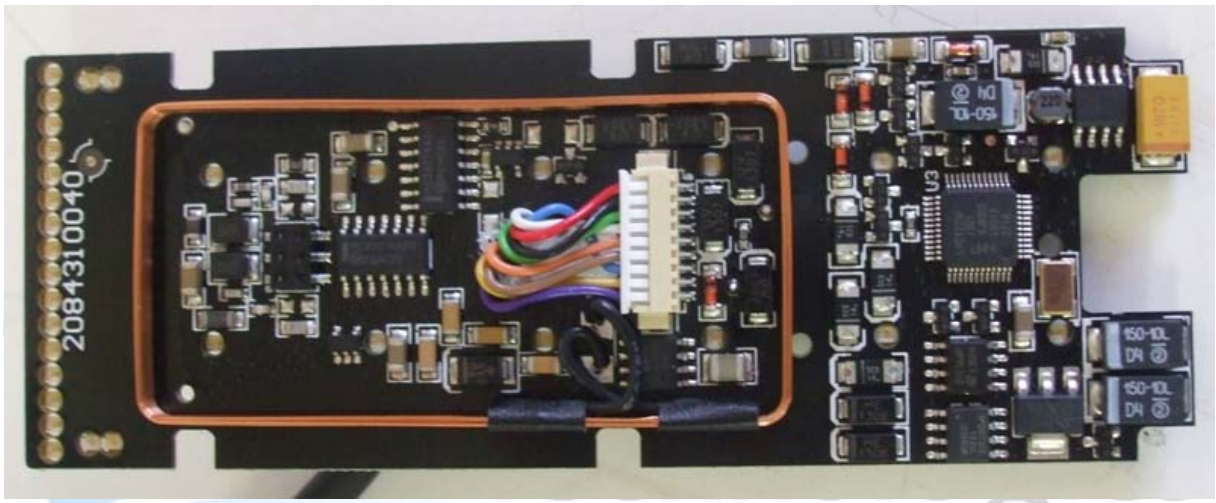


Peripheral device external and internal view

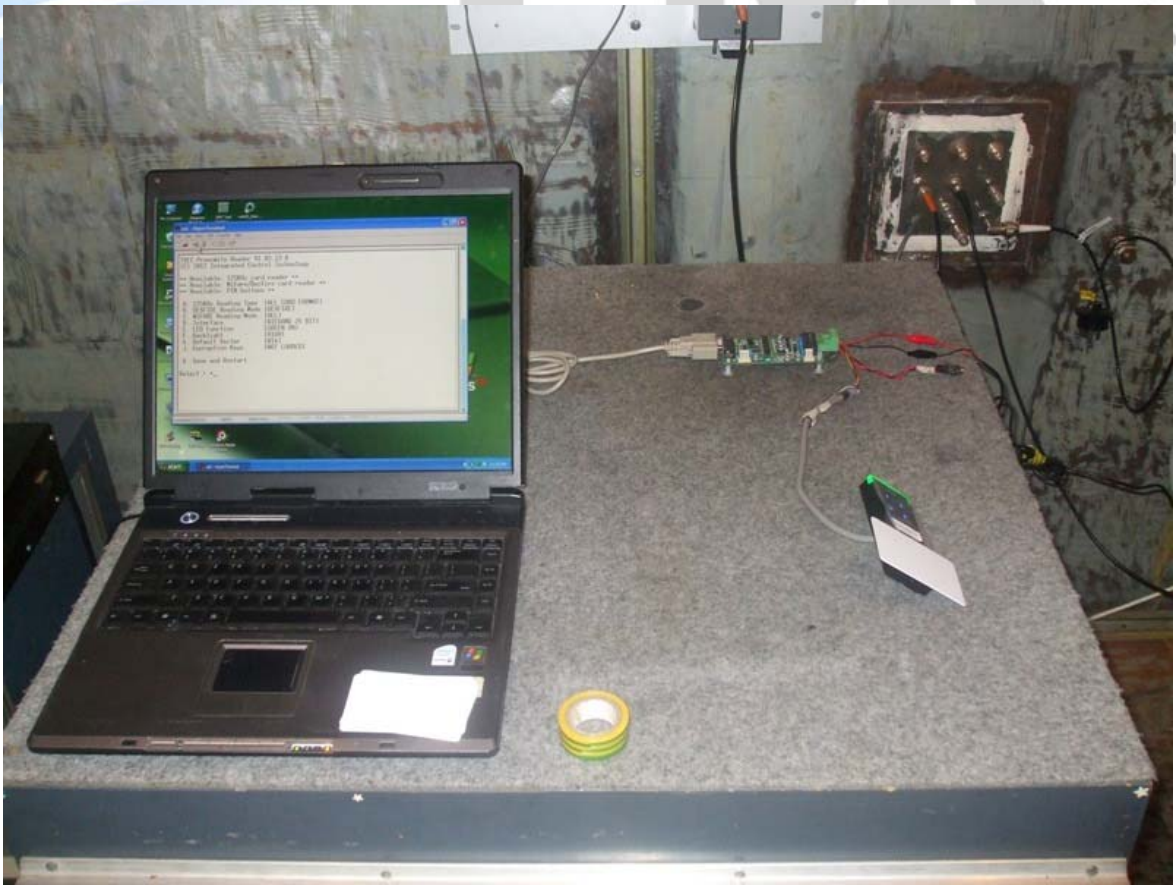


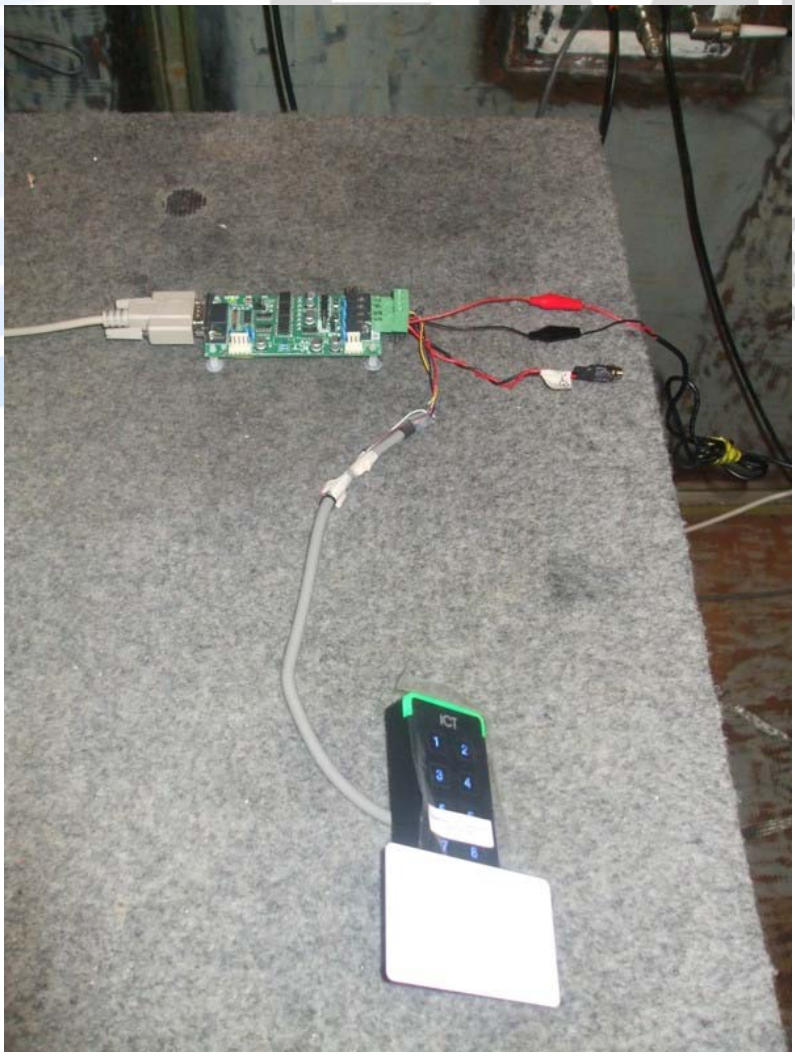
Device Under Test Internal Views

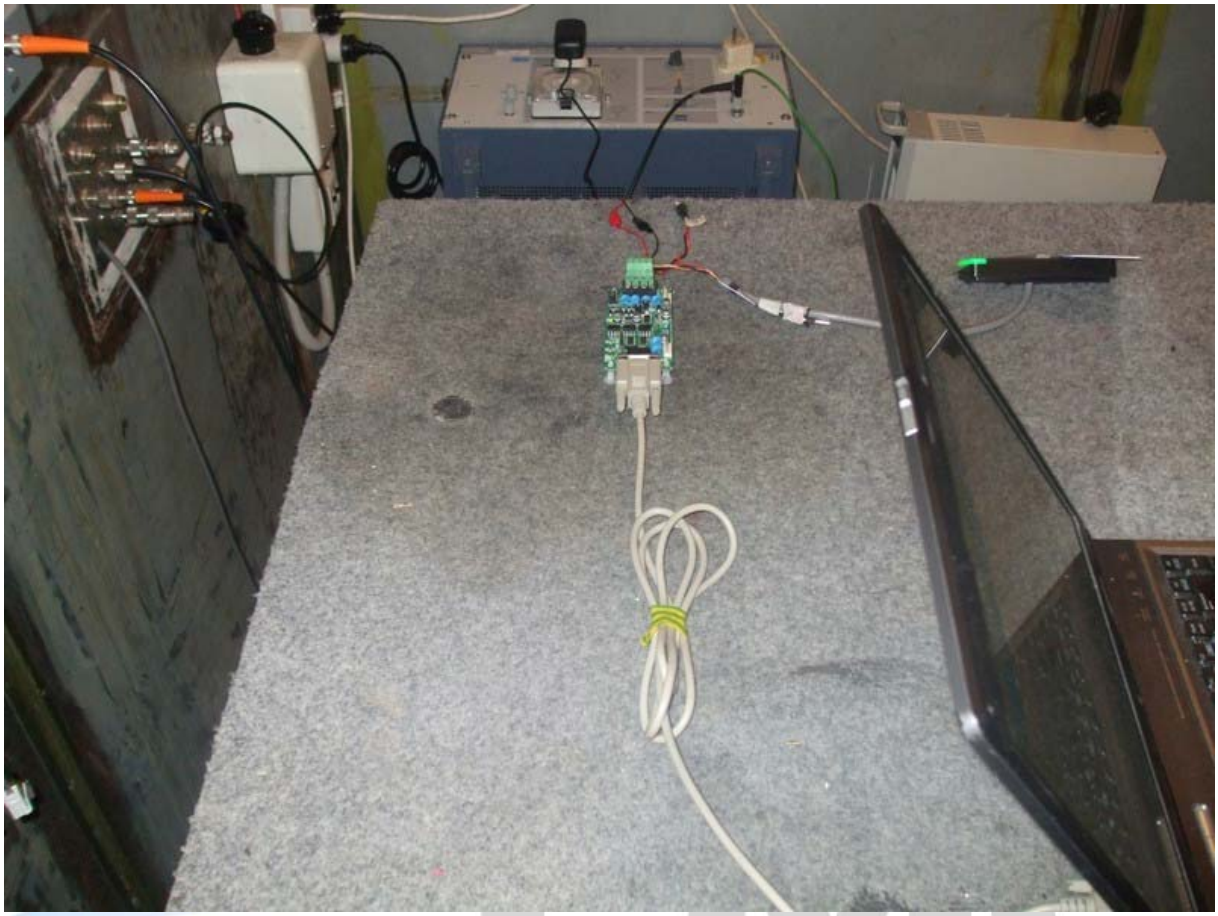




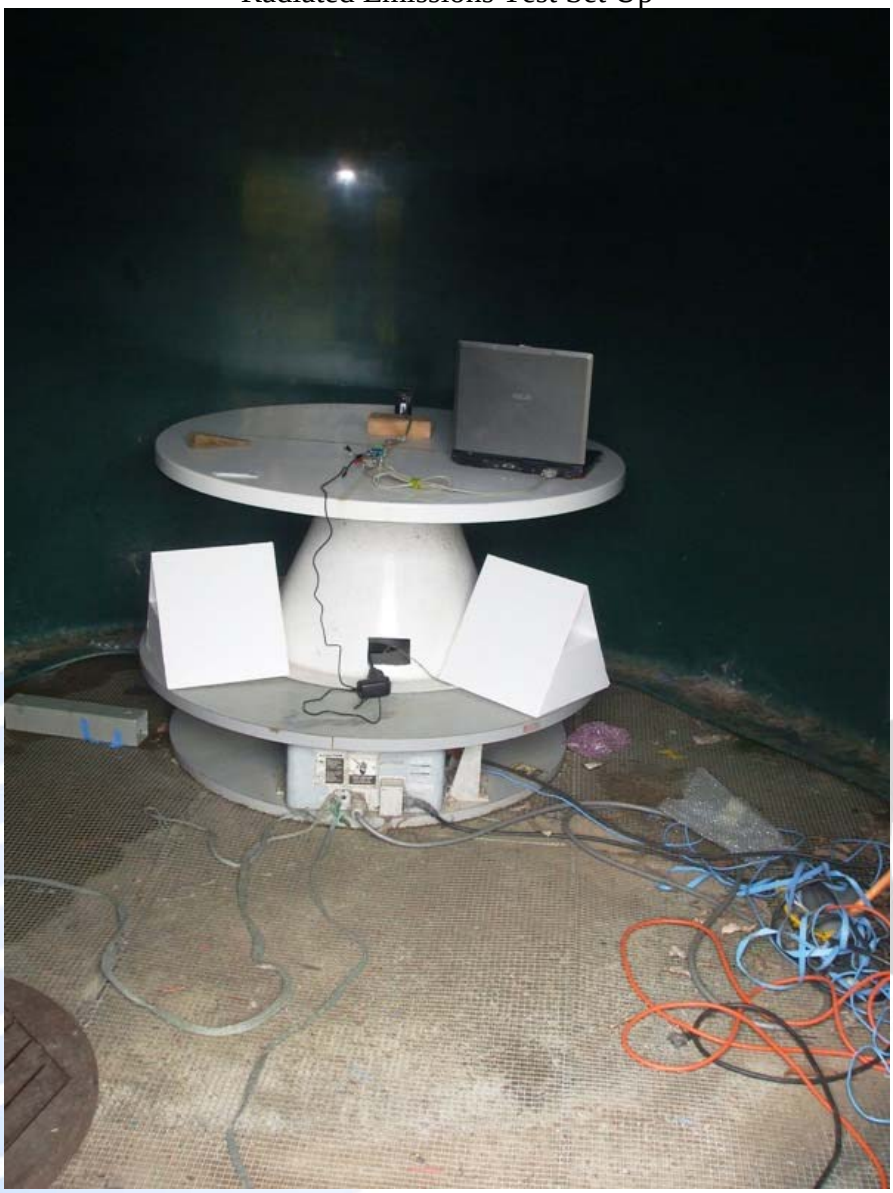
Conducted Emissions Test Set Up

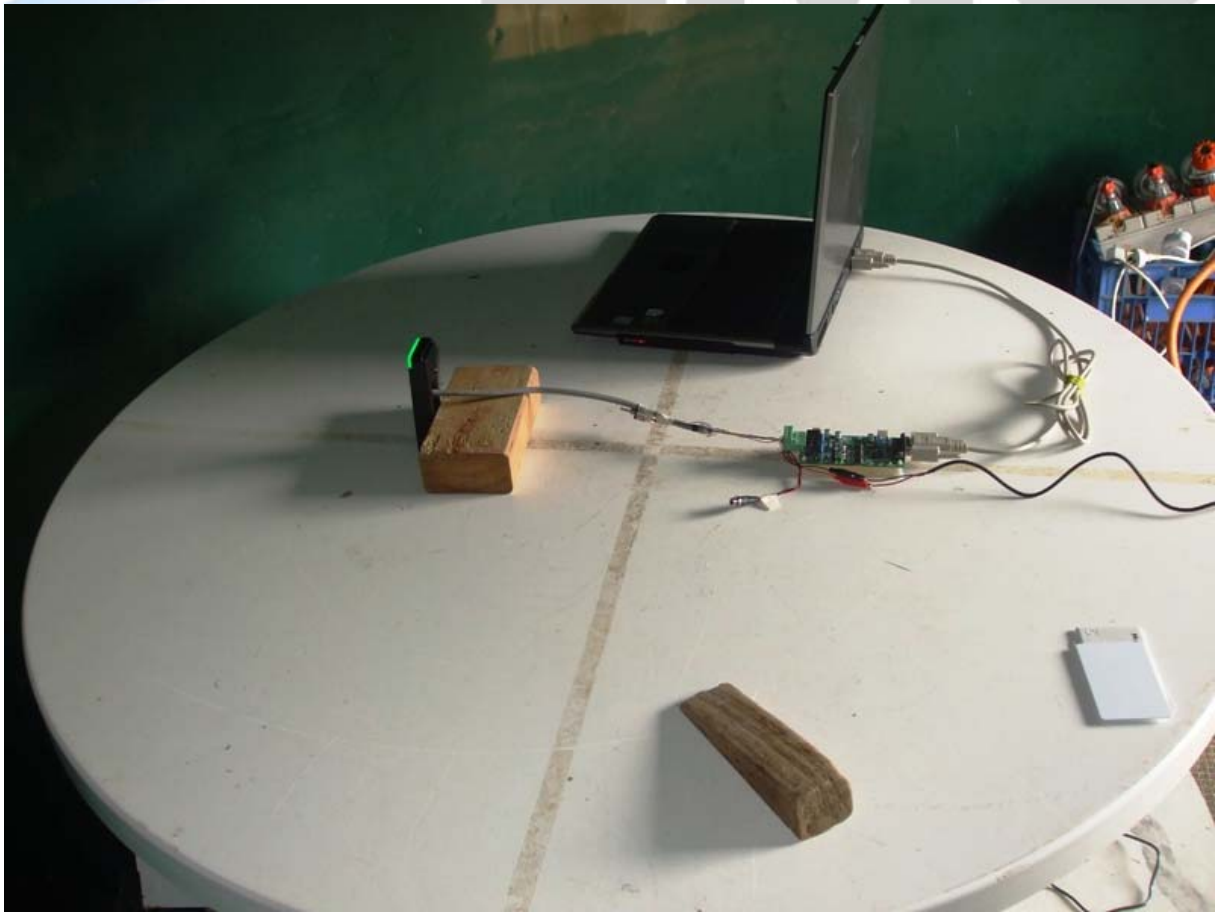




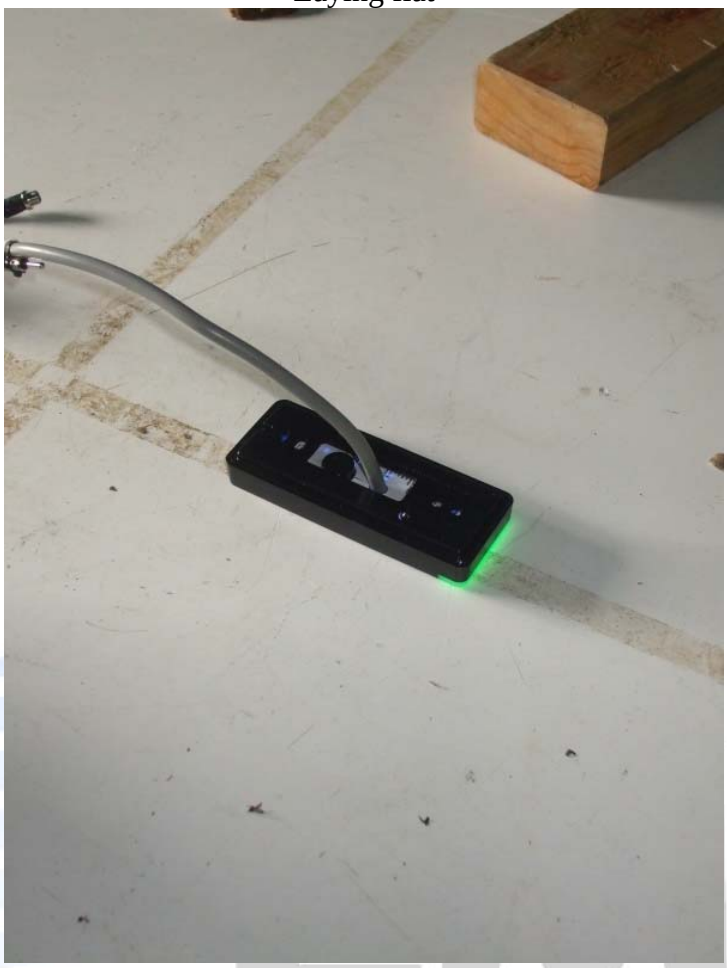


Radiated Emissions Test Set Up

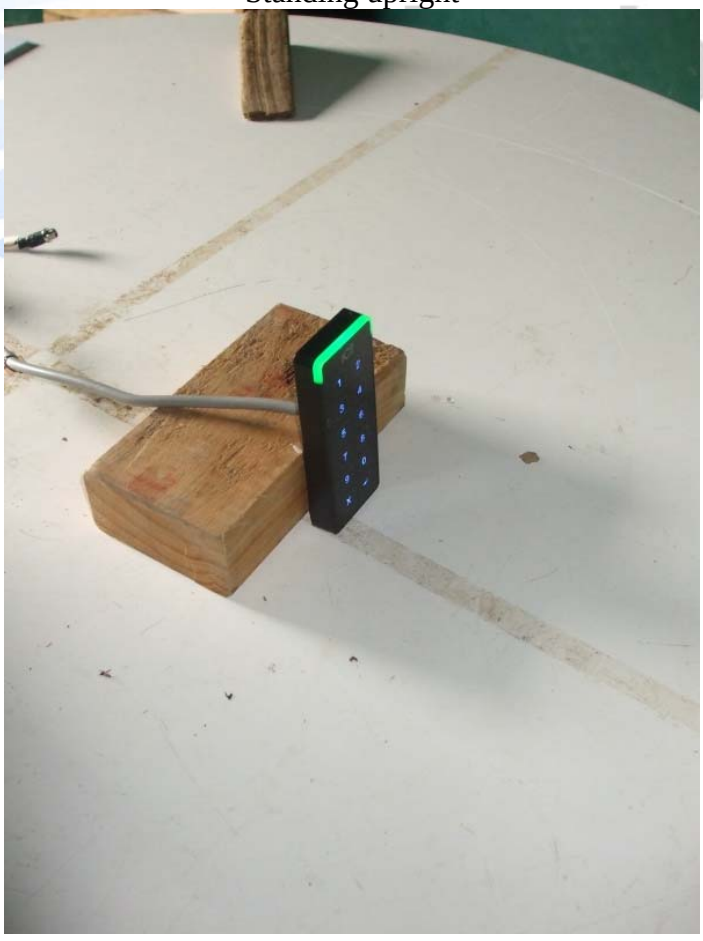




Laying flat



Standing upright



Laying on edge