TEST REPORT

Test Report No. : UL-RPT-RP10284207JD01A V3.0

Manufacturer	:	Paxton Access Ltd
Model No.	:	Paxlock US / 921-130-US
FCC ID	:	USE921130
Test Standard(s)	:	FCC Part 15.209

1. This test report shall not be reproduced in full or partial, without the written approval of UL VS LTD.
2. The results in this report apply only to the sample(s) tested.
3. The sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 3.0 supersedes all previous versions.

Date of Issue: 10 December 2014

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Issued by :

pp

John Newell
Quality Manager,
UL VS LTD

0644

This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its terms of accreditation.

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1. Customer Information

Company Name:	Paxton Access Ltd
Address:	Paxton House Home Farm Brighton Sussex BN1 9HU United Kingdom

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) – Section 15.209
Site Registration:	FCC: 209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	29 August 2014 to 01 December 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.209	Transmitter Fundamental Field Strength	✓
Part 15.209	Transmitter Radiated Emissions	✓
Key to Results ✓ = Complied ✗ = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI C63.4-2009
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10-2009
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	FCC KDB Publication Number 937606 Date: 10/10/2014
Title:	Test Site Requirements for Part 15 and 18 Devices Operating Below 30 MHz

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Paxton Access Ltd
Model Name or Number:	Paxlock US / 921-130-US
Test Sample Serial Number:	2616728
Hardware Version:	z-pl17 rev 8, ppc-pl17 rev E
Software Version:	V5.03.24
FCC ID:	USE921130

3.2. Description of EUT

The Equipment Under Test was an all-in-one battery powered locks and wireless access control system. The unit combines a 125 kHz proximity reader, 2.4 GHz wireless interface (IEEE 802.15.4) and a lockset.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Tested Technology:	RFID	
Power Supply Requirement:	Nominal	6 VDC
Type of Unit:	Transceiver	
Modulation Type:	AM	
Transmit Frequency	125 kHz	

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude E5500
Serial Number:	Not marked or stated

Description:	USB Bridge
Brand Name:	Net2Air
Model Name or Number:	477-268
Serial Number:	1730371

Description:	USB cable, 1.8 metres length
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated
Serial Number:	Not marked or stated

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Continuously transmitting with amplitude modulation at maximum power.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT was powered by four AA type batteries. New batteries were fitted before testing commenced and the voltage levels were monitored during testing.
- The required configuration on the EUT was selected by using the supplied customer software 'Net2Air USB Bridge & Nano Test Application'. This was achieved using a laptop PC provided by the manufacturer together with the Net2Air bridge. These were connected to the PC by the USB cable.
- To place the EUT in the required test condition, a communication link was established between the Net2Air bridge and EUT. This was achieved by pressing the 'Bind Nano' button on the test application and presenting the RFID token to the EUT to establish the bond. Once the bond has been achieved, the test application allowed the EUT to be placed in the required test mode.
- Once the EUT was in the correct test mode and transmitting, all support equipment was removed from the test site.
- The EUT was assembled into a door lock which in turn, was fitted to a portion of a door. Both parts were supplied by the manufacturer for test purposes. The only orientation that the EUT could be positioned was with the door lock vertically. This is the orientation that the EUT will be used in its normal mode of operation. All tests were carried out with the EUT in this orientation.
- Refer to Appendix 1 of this test report for details of radiated tests on an open field test site.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 Measurement Uncertainty for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter Fundamental Field Strength

Test Summary:

Test Engineer:	Georgios Vrezas	**Test Date:**	19 November 2014
Test Sample Serial Number:	2616728		

FCC Reference:	Part 15.209
Test Method Used:	As detailed in ANSI C63.10 Section 6.4, FCC KDB 937606, Notes below and Appendix 1

Environmental Conditions:

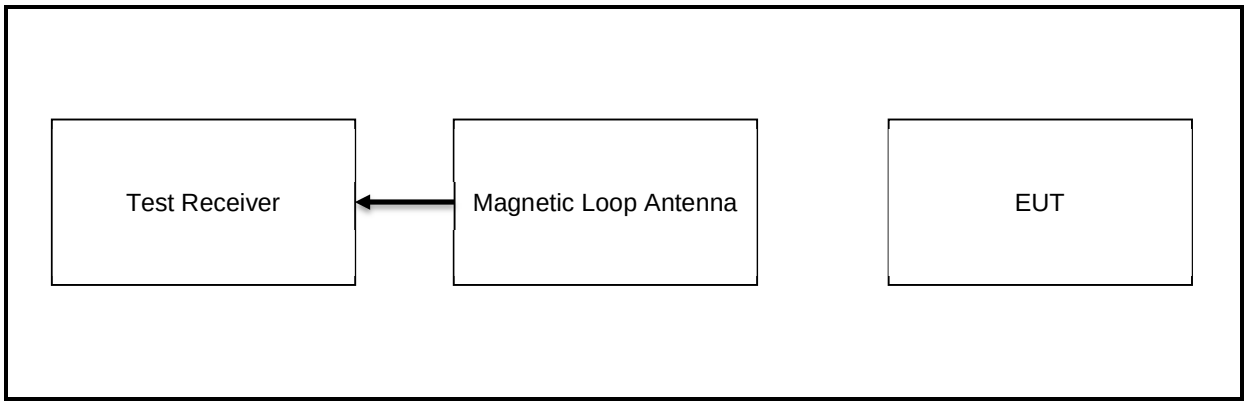
Temperature (°C):	3 to 10
Relative Humidity (%):	70 to 99

Note(s):

1. The limit is specified at a test distance of 300 metres. However, as specified by FCC Part 15.31(f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
2. In accordance with FCC KDB 937606, a *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a). It was not possible to determine the emission value at the test distances specified below 30 MHz on an open field test site, therefore in accordance with 47 CFR 15.31(f), measurements were made at closer distances. Background scans of the open field test site are shown in Appendix 1 of this test report.
3. Final measurements were performed with an average detector as stated in FCC Part 15.209(d).
4. A transducer factor was used on the spectrum analyser during open field tests. This factor includes correction between the fixed gain of the magnetic loop antenna and the calibration values. It also includes the value of the RF cable used to connect the antenna to the spectrum analyser which was incorporated into the annual calibration of the magnetic loop antenna
5. The fundamental field strength was below the measurement system noise floor at 30 metres, therefore measurements at 300 metres were not performed.
6. The fundamental field strength average level of 74.2 dBµV/m measured at a distance of 3 metres on an open field test site was extrapolated to the required distance of 300 metres using a 40 dB/decade extrapolation factor. The level at 300 metres was calculated as 74.2 dBµV/m – 80 dB = -5.8 dBµV/m.

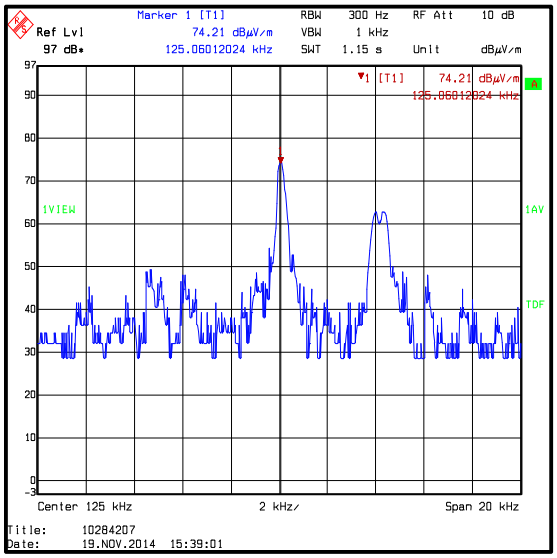
Transmitter Fundamental Field Strength (continued)

Test setup for transmitter fundamental field strength measurements:

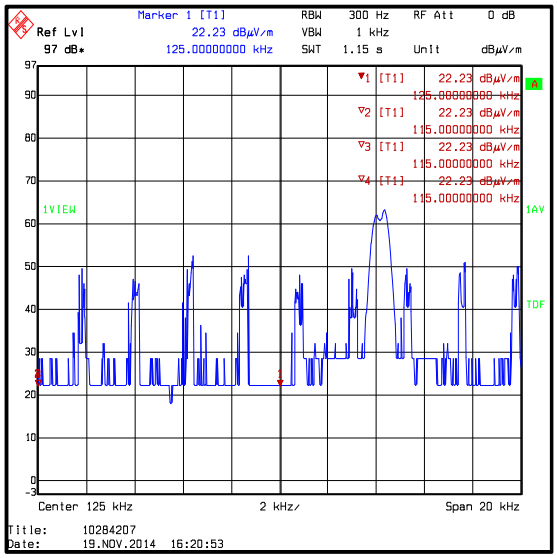


Results Average:

Frequency (kHz)	Measurement Antenna Position	Level at 300 m (dBµV/m)	Limit at 300 m (dBµV/m)	Margin (dB)	Result
125.060	Tip 90°to EUT	-5.8	25.7	31.5	Complied



Fundamental field strength / EUT operating / measured at 3 metres / measured on an open field test site



Fundamental field strength / EUT operating / measured at 30 metres / measured on an open field test site

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1782	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	21 Mar 2015	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	26 Feb 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB	842659/016	30 Sep 2015	12

5.2.2. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineers:	David Doyle & Georgios Vrezas	**Test Dates:**	29 August 2014 & 19 November 2014
Test Sample Serial Number:	2616728		

FCC Reference:	Part 15.209
Test Method Used:	ANSI C63.4 Section 8, FCC KDB 937606, Notes below and Appendix 1
Frequency Range:	9 kHz to 1 GHz

Environmental Conditions:

Temperature (°C):	3 to 24
Relative Humidity (%):	33 to 99

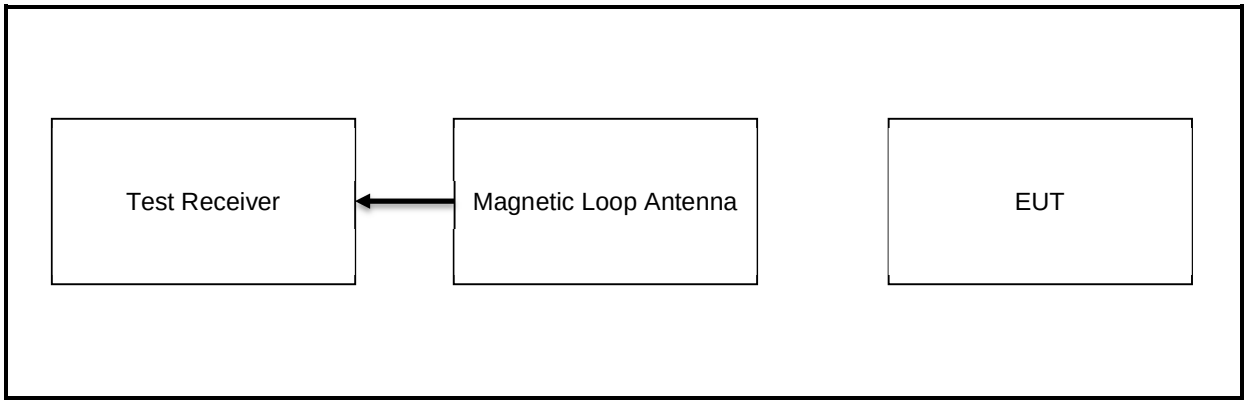
Transmitter Radiated Spurious Emissions (continued)

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss. Only spurious emissions in the range 30 MHz to 1 GHz were recorded. Markers were placed on the peaks of the prescan plot and final measurements were performed using a quasi-peak detector.
2. In accordance with FCC KDB 937606, a *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a) on an open field test site. It was not possible to determine the spurious emission values at the test distances specified below 30 MHz on an open field test site, therefore in accordance with 47 CFR 15.31(f), measurements were made at closer distances. Attempts were made to measure spurious emissions at 3 and 30 metres on an open field test site on 19 November 2014. Unfortunately, spurious emissions from the EUT could not be seen above the ambient emissions present at the open field test site or the noise floor of the measurement system. Final measurement results from the semi-anechoic chamber tests on 29 August 2014 are shown in this section. In addition, the open field test result plots for measurements between 9 kHz and 30 MHz are also shown. These measurement plots are identical to background scan plots of the open field test site. Background scans of the open field test site and further information are shown in Appendix 1 of this test report.
3. For frequencies below 490 kHz, spurious emissions were below the open area test site's noise floor or ambient emissions at 30 metres. Therefore measurements at 300 metres were not performed.
4. The emission shown at approximately 125 kHz is the fundamental emission frequency which was greater than 20 dB below the spurious emission limit.
5. The spurious emissions from 15 kHz to 54 kHz shown on the 9 kHz to 150 kHz plot taken in the semi-anechoic chamber at 3 metres were investigated and found to be radiating from the test site turntable.
6. All other emissions shown on the pre-scan plots were investigated and found to be >20 dB below the applicable limit, below the measurement system noise floor or ambient, therefore the highest measurement system noise floor level is recorded in the table below.
7. Measurements were performed in a semi-anechoic chamber (UL VS LTD Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Between 30 MHz & 1 GHz, maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
8. Measurement plots in this section for tests between 9 kHz and 30 MHz on an open field test site have markers placed on the highest level ambient emissions. This is for information only.
9. Limit lines shown on open field test site plots from 9 kHz to 490 kHz have been extrapolated using a factor of 40 dB/decade to a test distance of 30 metres and are for indication only.
10. A transducer factor was used on the spectrum analyser during open field tests. This factor includes correction between the fixed gain of the magnetic loop antenna and the calibration values. It also includes the insertion loss of the RF cable used to connect the antenna to the spectrum analyser which was incorporated into the annual calibration of the magnetic loop antenna.

Transmitter Radiated Spurious Emissions (continued)

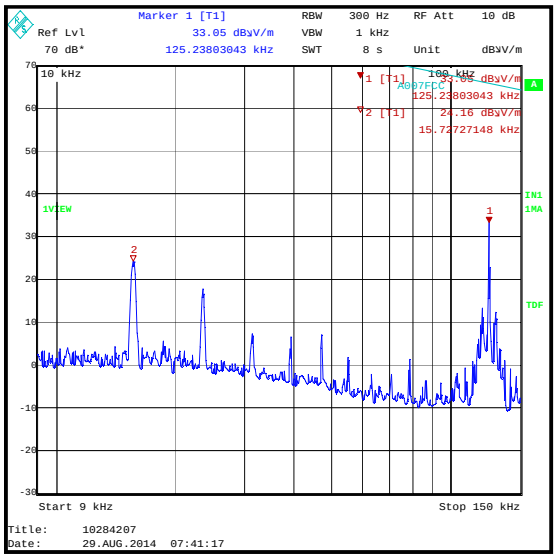
Test setup for transmitter fundamental field strength measurements:



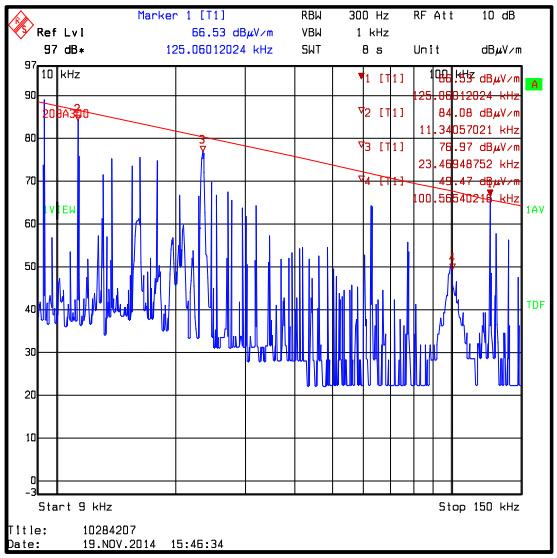
Results Quasi-peak:

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
973.768	Horizontal	28.2	46.0	17.8	Complied

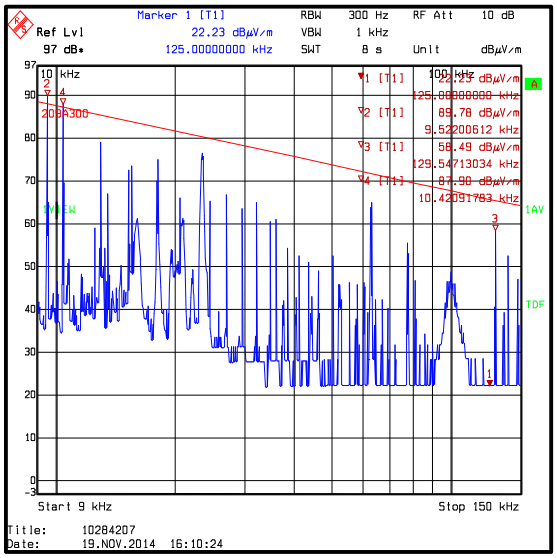
Transmitter Radiated Spurious Emissions (continued)



9 kHz to 150 kHz / peak detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



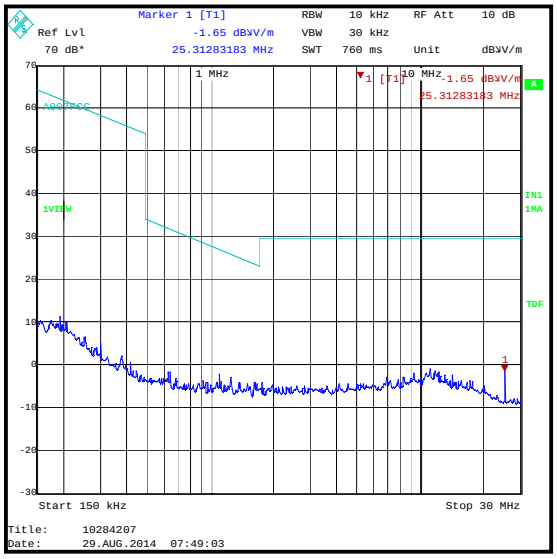
9 kHz to 150 kHz / average detector / EUT operating / measured at 3 metres on an open field test site



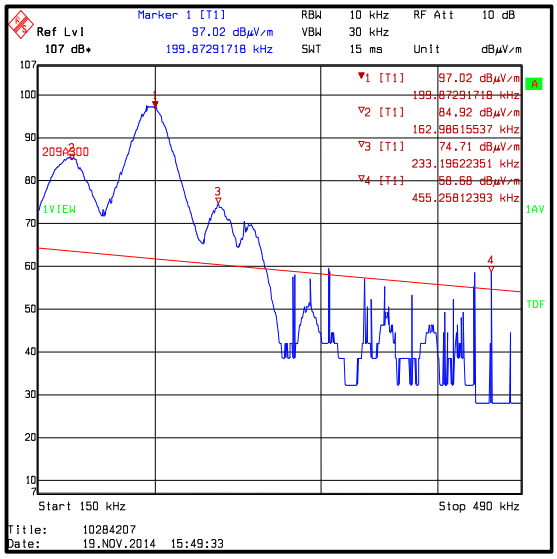
9 kHz to 150 kHz / average detector / EUT operating / measured at 30 metres on an open field test site

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

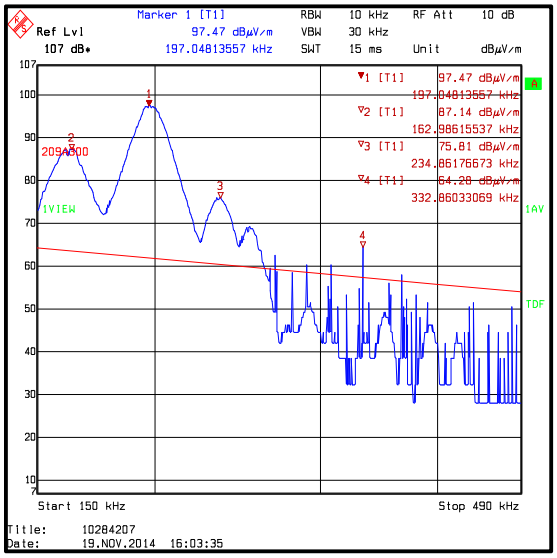
Transmitter Radiated Spurious Emissions (continued)



150 kHz to 30 MHz / peak detector (worst case) / EUT operating / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



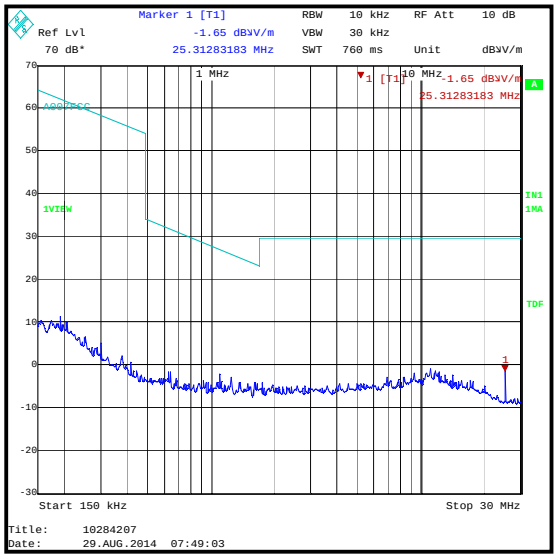
150 kHz to 490 kHz / average detector / EUT operating / measured at 3 metres on an open field test site



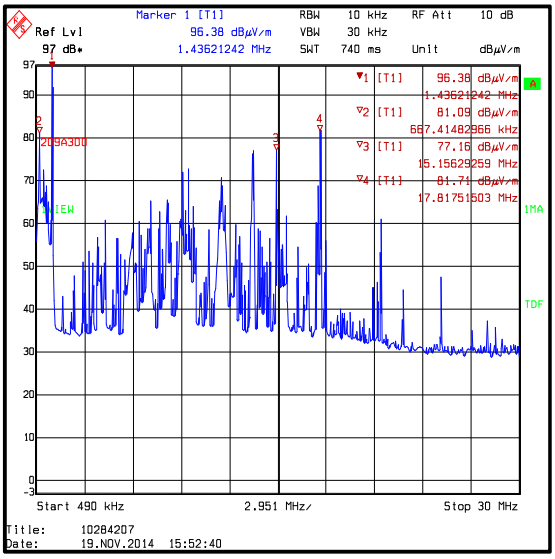
150 kHz to 490 kHz / average detector / EUT operating / measured at 30 metres on an open field test site

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

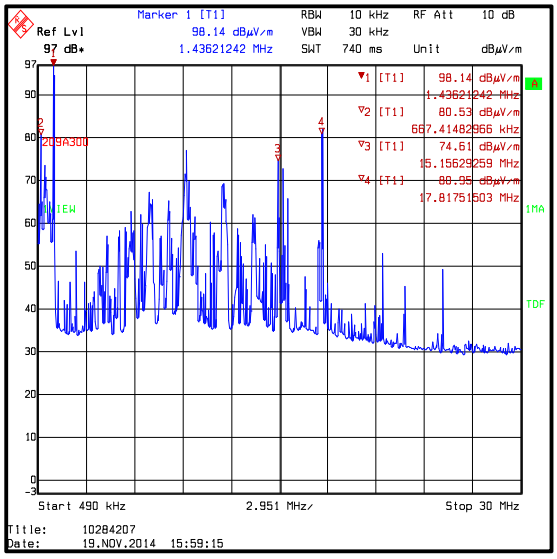
Transmitter Radiated Spurious Emissions (continued)



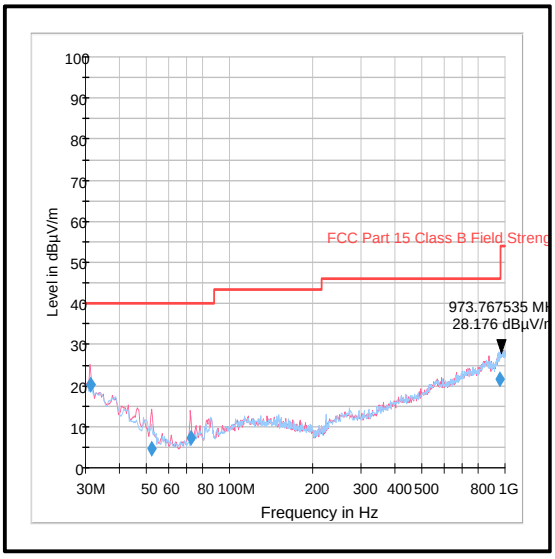
150 kHz to 30 MHz / peak detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



490 kHz to 30 MHz / peak detector / EUT operating / measured at 3 metres on an open field test site



490 kHz to 30 MHz / peak detector / EUT operating / measured at 30 metres on an open field test site



30 MHz to 1 GHz / peak detector (worst case) / measured at 3 metres in a semi-anechoic chamber

Transmitter Radiated Spurious Emissions (continued)

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1782	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	21 Mar 2015	12
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Dec 2014	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	26 Feb 2015	12
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB	842659/016	30 Sep 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 2015	12
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12
G0543	Amplifier	Sonoma	310N	230801	20 Nov 2014	3

NOTE: All equipment was within the calibration period on the date of testing.

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Transmitter Output Power	9 kHz to 30 MHz	95%	±3.73 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±3.73 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±5.65 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	**Clause**	**Details**
1.0	-	-	Initial Version
2.0	All	-	Added measurement data from open field test site and Appendix 1. Added additional notes as required. Test setup information added. RSS-Gen references updated. Test results updated as required.
3.0	All	-	Removed Industry Canada references at the request of the TCB.

8. Appendix 1

Test setup/arrangement of EUT during open field tests on 19 November 2014

Details of 3 metre and 30 metre open field test site used on 19 November 2014

GPS coordinates: 51.334017,-1.384317

Temperature: 3℃ to 10℃ Relative Humidity: 70% to 99%

Ground conditions: Wet

Arial view of test site. Red marker indicates test location

Set up for 3 metre measurements

Set up for 30 metre measurements

Measurements at 3 and 30 metres

The test site was free from underground metal objects.

The EUT was powered at its nominal voltage from fully charged batteries.

The EUT was placed on a plastic table at a height of 0.8 metres above ground level in accordance with ANSI C63.4-2009 Section 6.

The spectrum analyser used for measurements was located in a vehicle 30 metres from the magnetic loop antenna.

The test distance was from the centre of the mag loop antenna to the closest periphery of the EUT. This distance was maintained as the EUT was rotated.

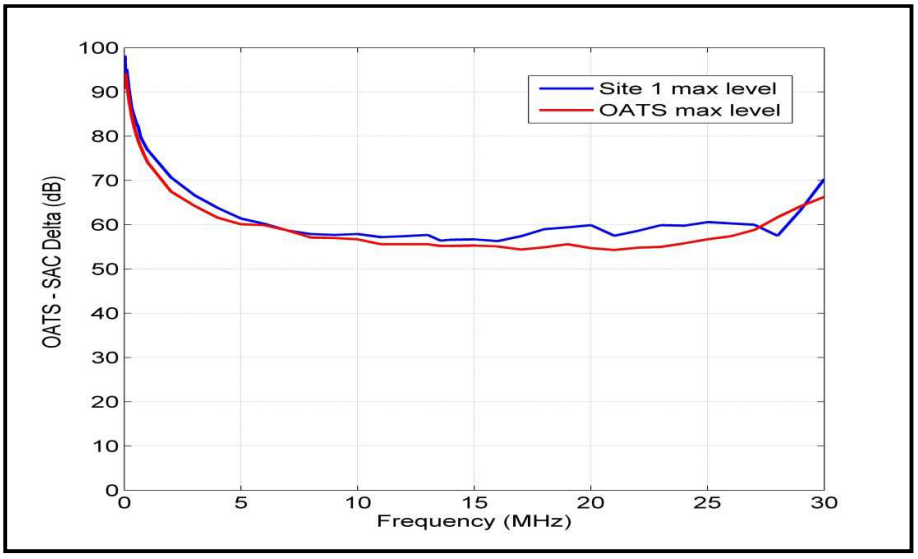
The EUT was rotated through 360 degrees in 60 degree steps at both measurement distances. The mag loop antenna was rotated through 90 degrees in 30 degree steps at every position the EUT was moved to.

Comparison of open field test site with semi-anechoic chamber measurements at 3 metres

Radiated measurements were performed an open field test site (referred to here as 'OATS') and within a 3 metre semi-anechoic chamber (referred to as 'Site 1').

For the signal source, a modified loop antenna was connected to a signal generator at the transmit side. A standard active magnetic loop antenna was connected to a spectrum analyser at the receive side. The signal generator was set to its maximum supported output power and the signal was transmitted to the spectrum analyser via the two antennas and associated RF cables.

A sweep in small frequency increments was performed from 9 kHz to 30 MHz. The sweep was repeatedly performed with both antennas rotated about the axis in various orientations. Received levels for all orientations were recorded and the maximum levels for the open field test site and the semi-anechoic chamber are shown on the graph below. Full data for both tests are archived on the UL VS LTD IT server and available for inspection on request.



The conclusion was that the open field test site compares well with the semi-anechoic chamber at a measurement distance of 3 metres. If anything, the semi-anechoic chamber results are generally slightly higher. This means that if the measurement passes in the semi-anechoic chamber, it will pass with a higher margin on an open field test site.

The magnetic loop antenna used to perform these measurements is the same antenna or same type of antenna used during measurements contained in this test report.

Verification of open field test site and semi-anechoic chamber measurements at 3 metres prior to performing measurements

Two reference units are used for verification of the measurement system before testing commences. Both reference units are door entry systems modified by the manufacturer for test purposes only.

One reference unit transmits a continuous, unmodulated signal at a fixed frequency of 125 kHz when a 12 Volt battery is connected. The output power is fixed and known to be stable.

The second transmits a continuous, unmodulated signal at a fixed frequency of 13.56 MHz when a 12 Volt battery is connected. The output power is fixed and known to be stable.

Both frequencies are commonly used RFID frequencies.

A UL VS LTD internal verification document explains the procedure in detail. A brief description is given below.

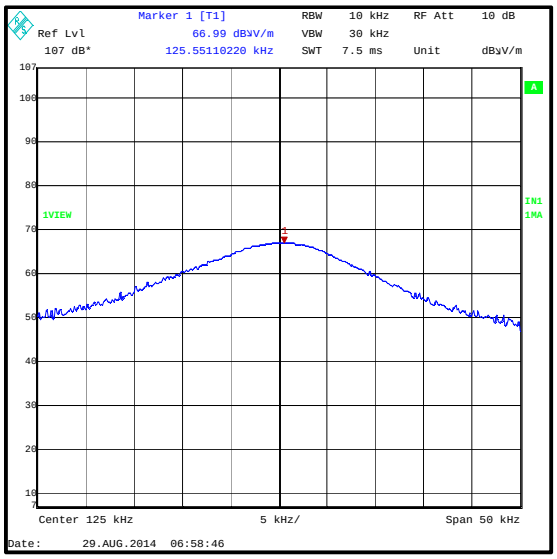
The centre of the magnetic loop antenna is placed exactly 3 metres from the reference unit. The reference unit is placed on a plastic table at a height of 0.8 metres above floor level and the centre of the mag loop antenna is 1 metre above the floor level. The mag loop antenna and reference unit are oriented in certain positions to ensure repeatability.

Each reference unit is connected to a 12 Volt battery and once transmitting, the maximum raw received level at each of the two frequencies is read on the spectrum analyser by using the marker peak function. The measured level has to be within certain levels as specified in the UL VS LTD internal test procedure. The plot of the verification measurement is archived on the UL VS LTD IT server. The peak level of each reference unit is recorded on a spreadsheet which is also archived on the UL VS LTD IT server.

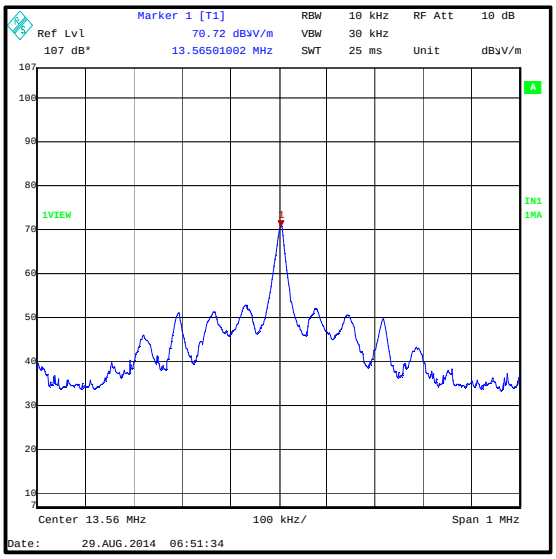
The internal verification procedure and verification plots are available for inspection on request.

Radiated measurements below 30 MHz were performed in a semi-anechoic chamber at a distance of 3 metres.

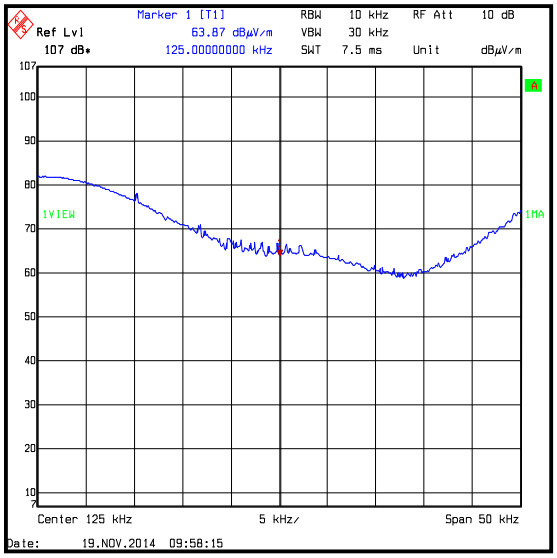
Verification plots of the two reference units at a measurement distance of 3 metres are shown on the following page. Plots were taken on an open field test site (19 November 2014) and in a semi-anechoic chamber (29 August 2014).



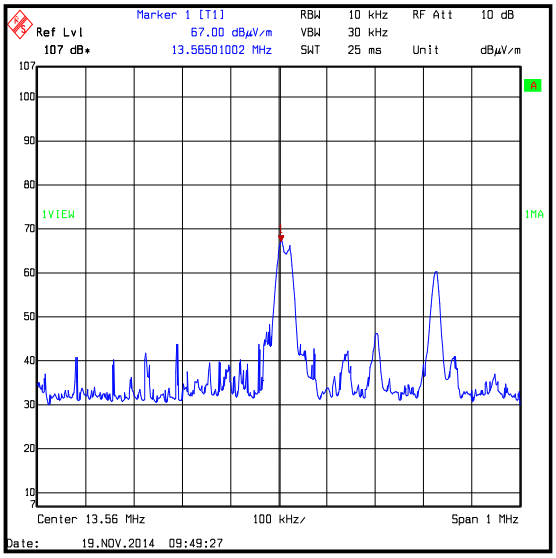
125 kHz reference unit signal at 3 metres in a semi-anechoic chamber on 29 August 2014



13.56 MHz reference unit signal at 3 metres in a semi-anechoic chamber on 29 August 2014



125 kHz reference unit signal at 3 metres on an open field test site on 19 November 2014

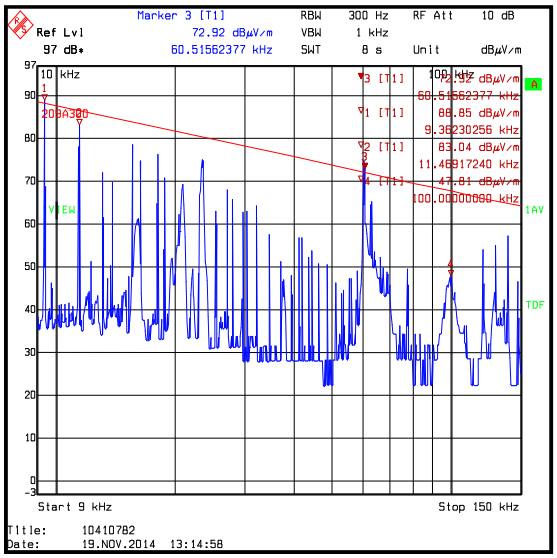


13.56 MHz reference unit signal at 3 metres on an open field test site on 19 November 2014

Note(s):

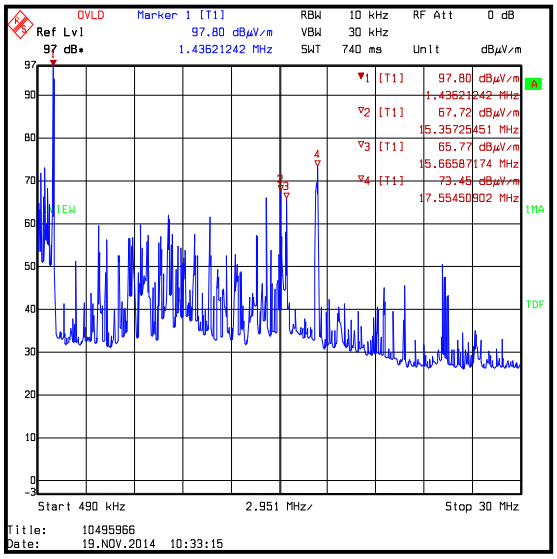
1. The above plots show comparable measurements of reference units on an open field test site and in a semi-anechoic chamber at spot frequencies.

Background scans of the open field test site



Frequency range: 9 kHz to 150 kHz
Average detector / background scan

Frequency range: 150 kHz to 490 kHz
Average detector / background scan



Frequency range: 490 kHz to 30 MHz
Peak detector / background scan

Note(s):

1. The above plots are background scans of the test site. The EUT was turned off when the background scans were performed.
2. The job numbers on the above plots correspond to different jobs. This does not affect the results since they are background scans of the open field test site and the test dates of the various jobs are the same.

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