



TEST REPORT

Test Report No. : UL-RPT-RP10495966JD02A

Manufacturer : Datecs Ltd
Model No. : INFINEA X
FCC ID : YRWDATECSBTIX
Technology : RFID – 13.56 MHz
Test Standard(s) : FCC Parts 15.207, 15.209(a) & 15.225

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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 1.0.

Date of Issue: 06 January 2015

Checked by:

Ian Watch
Senior Engineer, Radio Laboratory

Issued by :

pp

John Newell
Quality Manager
UL VS LTD



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:	Datecs Ltd
Address:	4 Datecs, 1592 Sofia, Bulgaria

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.225
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Radio Frequency Devices) - Section 15.225
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Site Registration:	209735
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	16 October 2014 to 19 November 2014

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 15.207	Transmitter AC Conducted Emissions	
Part 15.225(a)(b)(c)(d)	Transmitter Fundamental Field Strength	
Part 15.209(a)/15.225(d)	Transmitter Radiated Emissions	
Part 15.209(a)/15.225(c)(d)	Transmitter Band Edge Radiated Emissions	
Part 15.225(e)	Transmitter Frequency Stability (Temperature & Voltage Variation)	
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:	Datecs
Model Name or Number:	INFINEA X
Test Sample Serial Number:	MAR003431UN14
Hardware Version:	C018910
Software Version:	IBBLRF 5.54.0
FCC ID:	YRWDATECSBTIX

3.2. Description of EUT

The Equipment Under Test was an iPhone case with an RFID barcode reader, operating at 13.56 MHz. It is powered from a 3.7 Volt battery.

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	
Category of Equipment:	Transceiver	
Channel Spacing:	Single channel device	
Transmit Frequency Range:	13.56 MHz	
Power Supply Requirement:	Nominal	3.7 V
	Minimum	3.6 V
	Maximum	4.2 V
Tested Temperature Range:	Minimum	-20°C
	Maximum	50°C

3.5. Support Equipment

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

Description:	iPhone 5
Brand Name:	Apple
Model Name or Number:	MD203LL
IMEI:	013428005248776

Description:	USB Charger
Brand Name:	Apple
Model Name or Number:	A1385
Serial Number:	Not marked or stated

Description:	Communication cable, length 1.6 metres
Brand Name:	MoreEase International Inc.
Model Name or Number:	ME-5005-0005
Serial Number:	Not marked or stated

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude E5410
Serial Number:	DQC78L1

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Constantly transmitting at full power with a modulated carrier in RFID test mode.

4.2. Configuration and Peripherals

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

- An iPhone was fitted to the EUT during all tests. The iPhone was turned off.
- The RFID transmitter test mode was enabled by means of a test application (Murata Mifare) provided by the customer and installed on a laptop PC.
- The EUT was connected to the laptop via a USB cable. Once the EUT was set to transmit the USB cable was disconnected from the laptop PC.
- For AC conducted emissions, fundamental field strength, radiated spurious emissions and band edge radiated emissions tests, the USB cable was connected to the USB charger.
- Testing at voltage extremes was performed with the EUT powered by an external DC power supply. The EUT's battery was removed and the bench power supply was connected to the EUT's battery terminals.
- AC conducted emissions tests were performed with the EUT connected to a USB charger via a USB cable. The AC charger was connected to a 120 VAC 60 Hz single phase supply via a LISN.
- 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 Uncertainties* 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 AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Georgios Vrezas	Test Date:	17 October 2014
Test Sample Serial Number:	MAR003431UN14		

FCC Reference:	Part 15.207
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

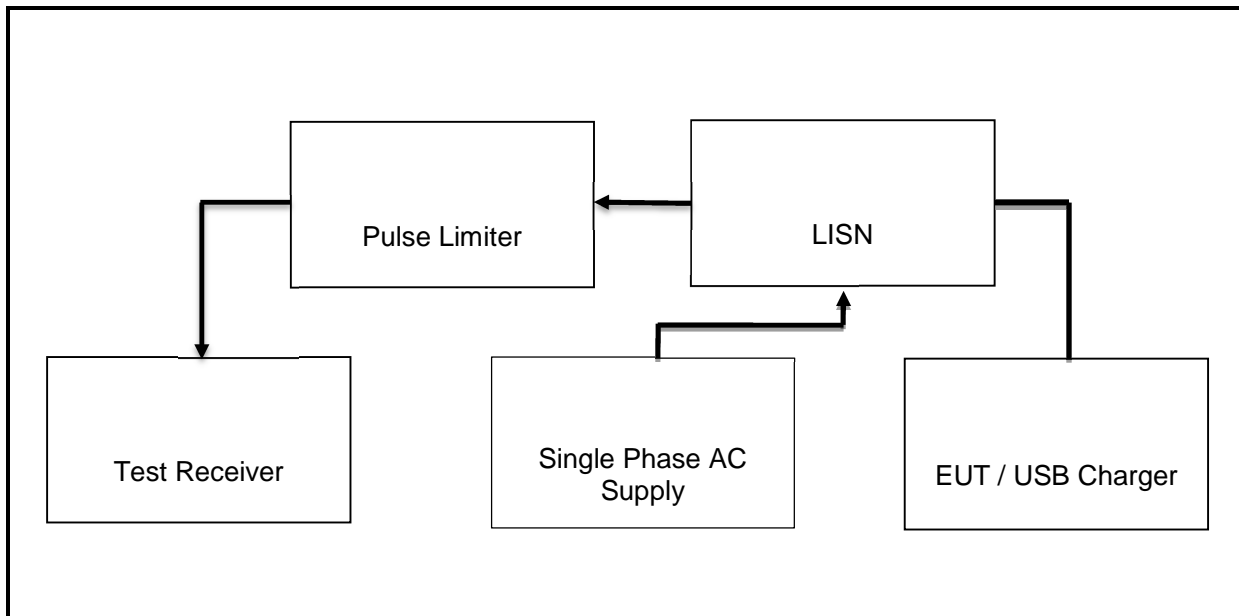
Environmental Conditions:

Temperature (°C):	22
Relative Humidity (%):	60

Note(s):

1. The EUT was initially tested with the standard antenna connected. The carrier at 13.56 MHz was found to be non-compliant as it exceeded the test limit. The customer modified the EUT by disconnecting the standard antenna and fitting a load with the same electrical properties in accordance with ANSI C63.10 Section 6.2.5 and FCC KDB 174176. The test was then repeated and the EUT was found to be compliant.
2. * Test results prior to modification of the EUT (standard antenna)
3. ** Test results with modified sample (transmitter terminated into 50 Ohm load)

Test setup for AC conducted spurious emissions measurements:



Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak**

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.249	Live	41.3*	61.8	20.5	Complied
0.416	Live	33.0*	57.5	24.5	Complied
0.510	Live	28.7*	56.0	27.3	Complied
0.659	Live	25.0*	56.0	31.0	Complied
13.560	Live	36.7**	60.0	23.3	Complied
22.083	Live	18.8*	60.0	41.2	Complied

Results: Live / Average

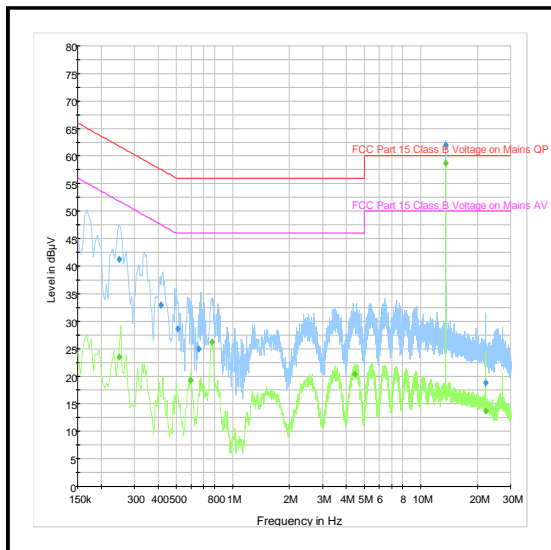
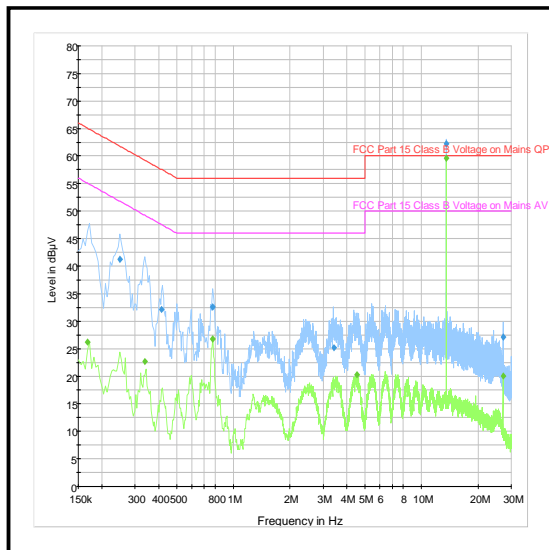
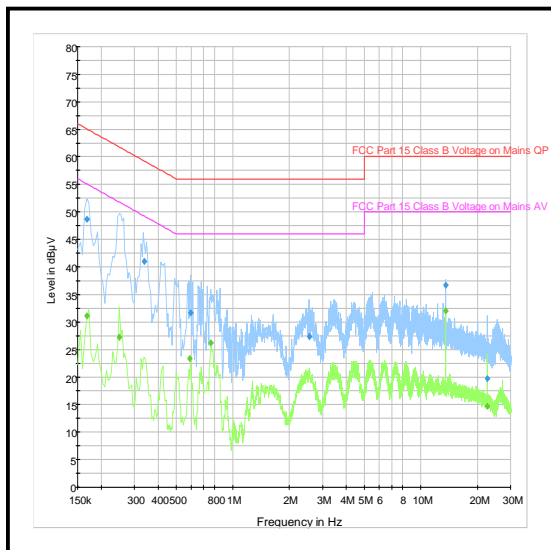
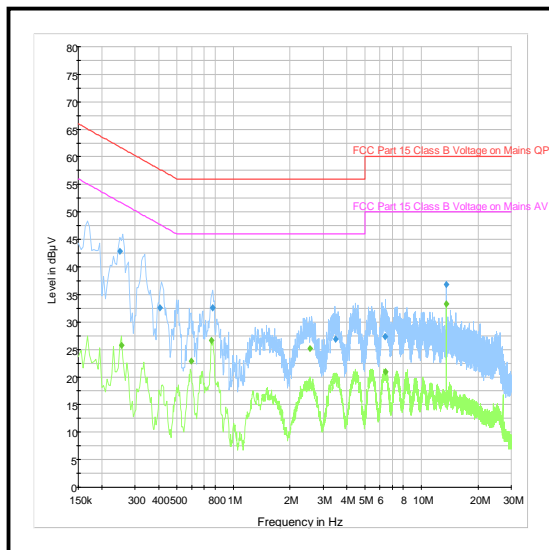
Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.249	Live	23.5*	51.8	28.3	Complied
0.596	Live	19.3*	46.0	26.7	Complied
0.776	Live	26.2*	46.0	19.8	Complied
4.439	Live	20.4*	46.0	25.6	Complied
13.560	Live	32.0**	50.0	18.0	Complied
22.101	Live	13.7*	50.0	36.3	Complied

Results: Neutral / Quasi Peak

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.249	Neutral	41.3*	61.8	20.5	Complied
0.416	Neutral	32.1*	57.5	25.4	Complied
0.776	Neutral	32.6*	56.0	23.4	Complied
3.426	Neutral	25.2*	56.0	30.8	Complied
13.560	Neutral	36.8**	60.0	23.2	Complied
27.119	Neutral	27.1*	60.0	32.9	Complied

Results: Neutral / Average

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.168	Neutral	26.2*	55.1	28.9	Complied
0.339	Neutral	22.7*	49.2	26.5	Complied
0.776	Neutral	26.8*	46.0	19.2	Complied
4.524	Neutral	20.3*	46.0	25.7	Complied
13.560	Neutral	33.3**	50.0	16.7	Complied
27.119	Neutral	20.0*	50.0	30.0	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Live****Neutral****Test results prior to modification of the EUT (standard antenna)****Live****Neutral****Test results with modified sample (transmitter terminated into 50 Ohm load)**

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

Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1625	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
A004	LISN	Rohde & Schwarz	ESH3-Z5	890604/027	18 Nov 2014	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	27 Feb 2015	12
M1263	Test Receiver	Rohde & Schwarz	ESIB 7	100265	14 Nov 2014	12

5.2.2. Transmitter Fundamental Field Strength**Test Summary:**

Test Engineer:	Georgios Vrezas	Test Dates:	16 October 2014 & 19 November 2014
Test Sample Serial Number:	MAR003431UN14		

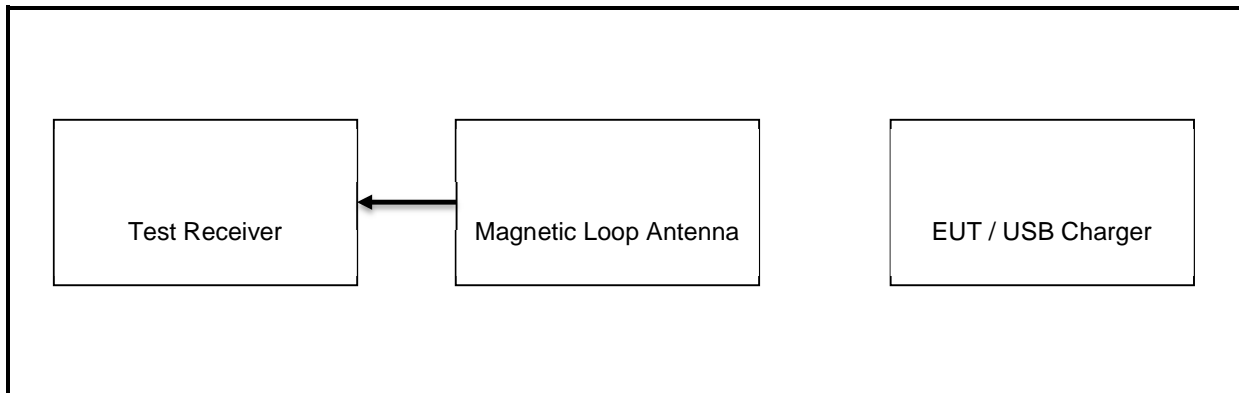
FCC Reference:	Part 15.225(a)(b)(c)(d)
Test Method Used:	As detailed in ANSI C63.10 Section 6.4, FCC KDB 937606, Notes below and Appendix 1

Environmental Conditions:

Temperature (°C):	3 to 23
Relative Humidity (%):	37 to 99

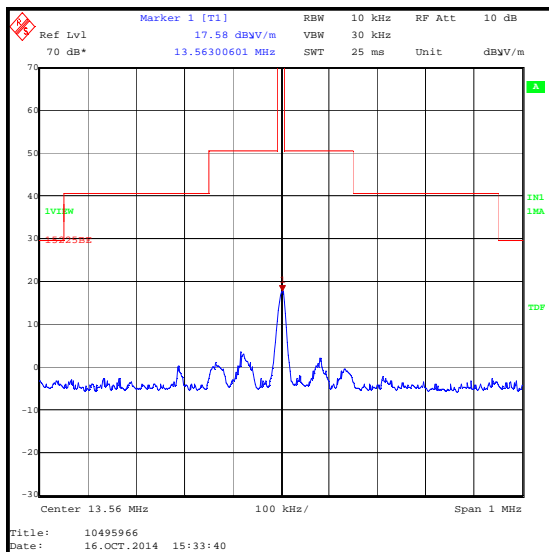
Note(s):

1. The limit is specified at a test distance of 30 metres. However, as specified by FCC Section 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 (40dB/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. Attempts were made to measure the fundamental at 30 metres on an open field test site on 19 November. Unfortunately the emission could not be seen above the ambient emissions or the noise floor of the measurement system at a distance of 30 metres. Background scans of the open field test site and further information are shown in Appendix 1 of this test report.
3. The level of the transmitter fundamental field strength at 3 metres on an open field test site is used to show compliance to the limit.
4. Pre-scan measurements were performed using a spectrum analyser with a peak detector and measurement bandwidth of 10 kHz. The fundamental field strength was maximized by rotating the measurement antenna and EUT. A peak level of 57.1 dBµV/m at a measurement distance of 3 metres was recorded and shown on the pre-scan plot below. The spectrum analyser was then switched to test receiver mode and the final measurement on the maximized level was performed. In accordance with ANSI C63.10 Clause 4.2.3.2.1 and CISPR 16-1-1, a quasi-peak detector was used in conjunction with a measurement bandwidth of 9 kHz and 0.2 second sweep time. A quasi-peak level of 56.6 dBµV/m was recorded. The quasi-peak level of 56.6 dBµV/m is the fundamental field strength at 3 metres. The corrected level to the specified measurement distance (using a linear distance extrapolation factor of 40 dB/decade) is 16.6 dBµV/m.
5. Due to the ambient emissions present on the open field test site, compliance with the spectrum mask is shown by measurements performed in a semi-anechoic chamber. For the field strength measurements in a semi-anechoic chamber, a transducer factor on the measuring instrument was used to extrapolate the results at 3 metres to a distance of 30 metres. A distance extrapolation factor of 40 dB was used.
6. 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.

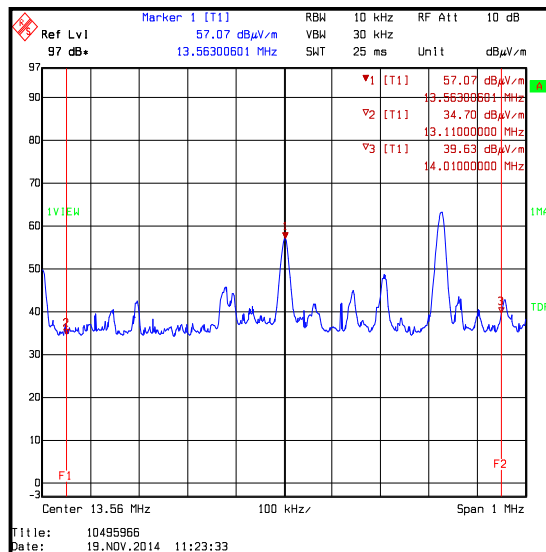
Transmitter Fundamental Field Strength (continued)**Test setup for transmitter fundamental field strength measurements:**

Transmitter Fundamental Field Strength (continued)**Results: Quasi Peak**

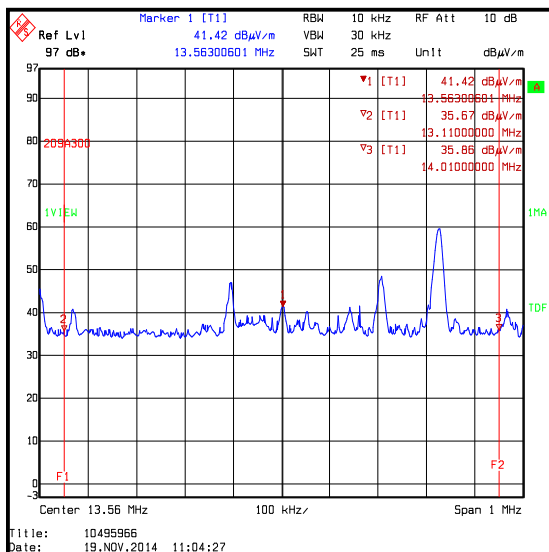
Frequency (MHz)	Measurement Antenna Position	Level (dB μ V/m)	Limit at 30 m (dB μ V/m)	Margin (dB)	Result
13.56	Tip rotated 30° from EUT	16.6	84.0	67.4	Complied



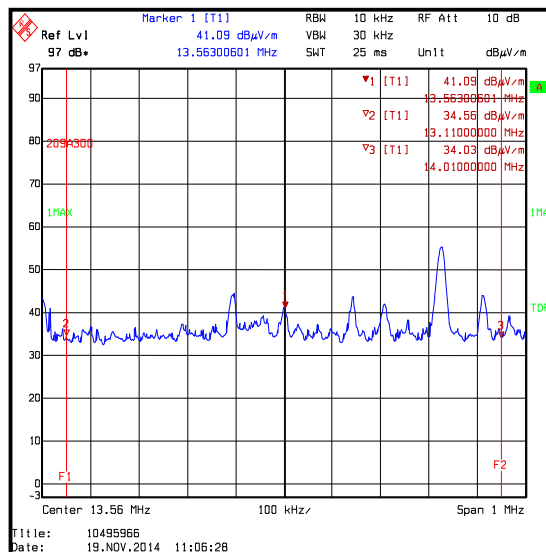
**Fundamental field strength and spectrum mask /
measured at 3 metres extrapolated to 30 metres /
measured in a semi-anechoic chamber**



**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**



**EUT off / Background scan of the open field test site
showing an unwanted ambient emission at 13.56 MHz**

Transmitter Fundamental Field Strength (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
M1782	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	21 Mar 2015	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	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
M1273	Test Receiver	Rohde & Schwarz	ESIB 26	100275	15 Feb 2015	12

5.2.3. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineer:	Georgios Vrezas	Test Dates:	16 October 2014 06 November 2014 & 19 November 2014
Test Sample Serial Number:	MAR003431UN14		

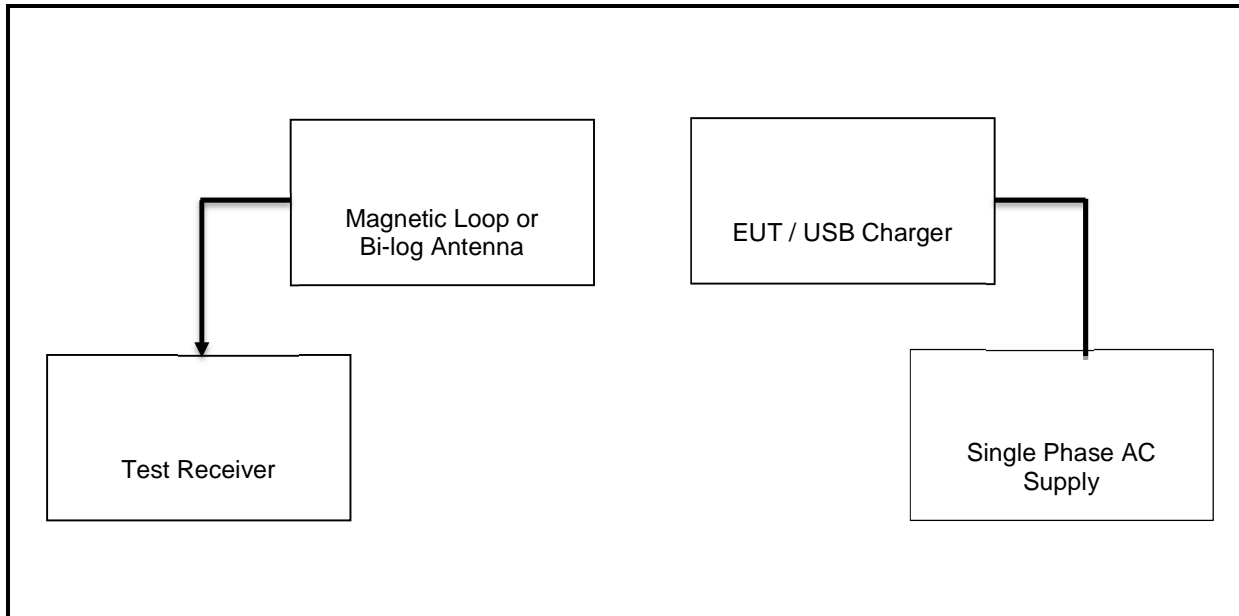
FCC Reference:	Parts 15.225(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3, 6.4 and 6.5 referencing ANSI C63.4
Frequency Range:	9 kHz to 1000 MHz

Environmental Conditions:

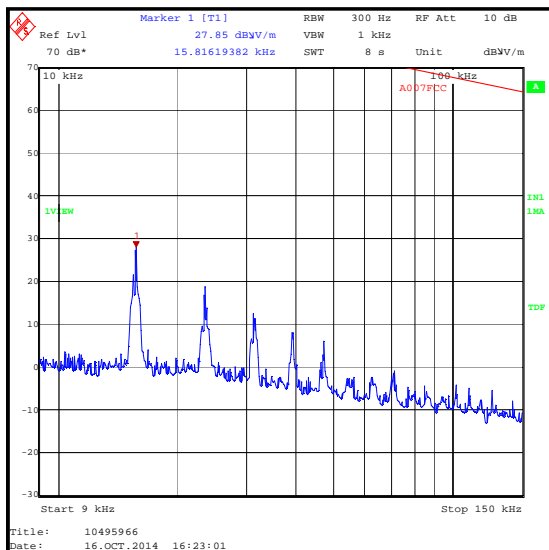
Temperature (°C):	5 to 23
Relative Humidity (%):	37 to 99

Note(s):

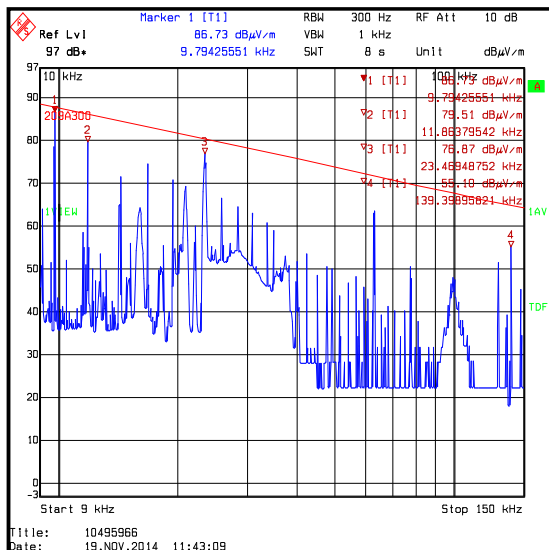
1. In accordance with FCC KDB 937606, a *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a) on an open field test site. It was not possible to determine the spurious emission values at the test distances specified below 30 MHz on an open field test site, therefore in accordance with 47 CFR 15.31(f), measurements were made at closer distances. Attempts were made to measure spurious emissions at 3, 30 and 300 metres on an open field test site on 06 November and 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 16 October 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.
2. 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.
3. All other emissions were greater than 20 dB below the applicable limit, below the noise floor of the measurement system or ambient.
4. Measurements on 16 October 2014 were performed in a semi-anechoic chamber (UL VS LTD Asset Number K0001) at a distance of 3 metres. The EUT loop was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Between 30 MHz and 1 GHz, maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
5. 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.
6. 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.
7. 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.

Transmitter Radiated Spurious Emissions (continued)**Test setup for Transmitter Radiated Spurious Emissions measurements:****Results: Quasi Peak**

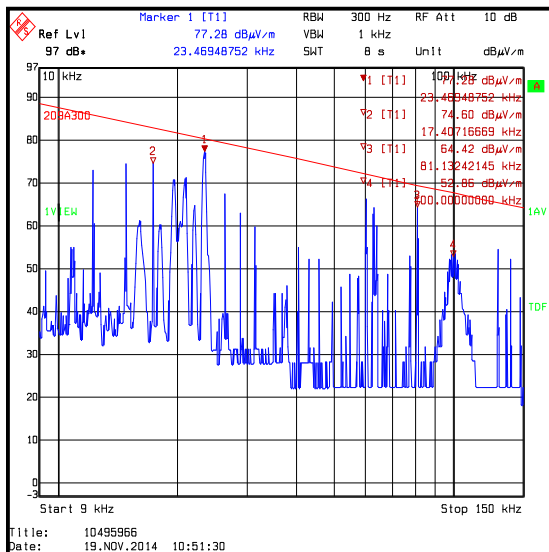
Frequency (MHz)	Antenna Polarity	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
596.652	Horizontal	28.4	46.0	17.6	Complied
840.734	Horizontal	35.6	46.0	10.4	Complied

Transmitter Radiated Spurious Emissions (continued)

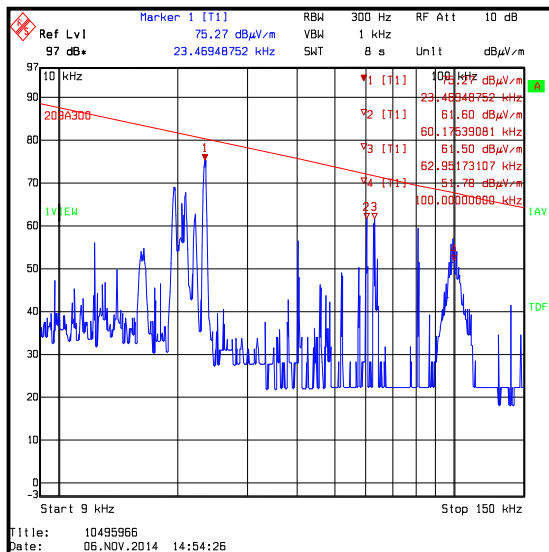
9 kHz to 150 kHz / peak detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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

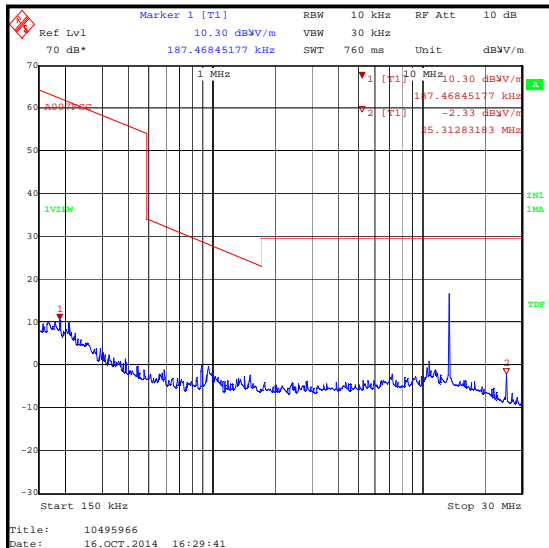


9 kHz to 150 kHz / average detector / EUT operating / measured at 30 metres on an open field test site

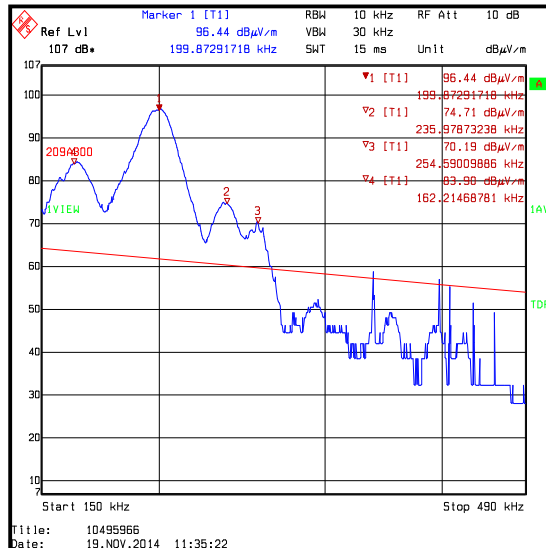


9 kHz to 150 kHz / average detector / EUT operating / measured at 300 metres on an open field test site

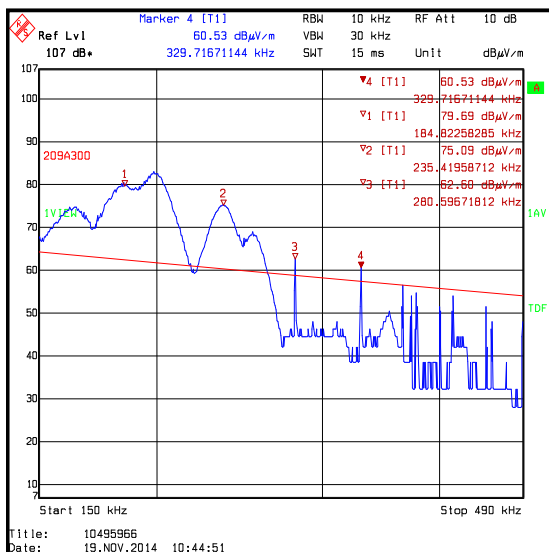
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Spurious Emissions (continued)

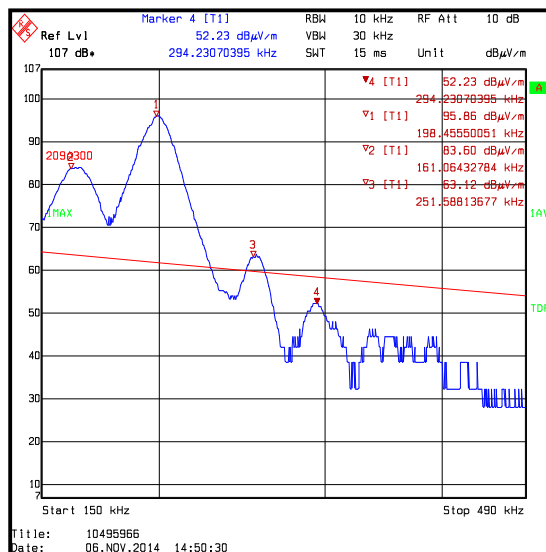
150 kHz to 30 MHz / peak detector (worst case) / EUT operating / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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

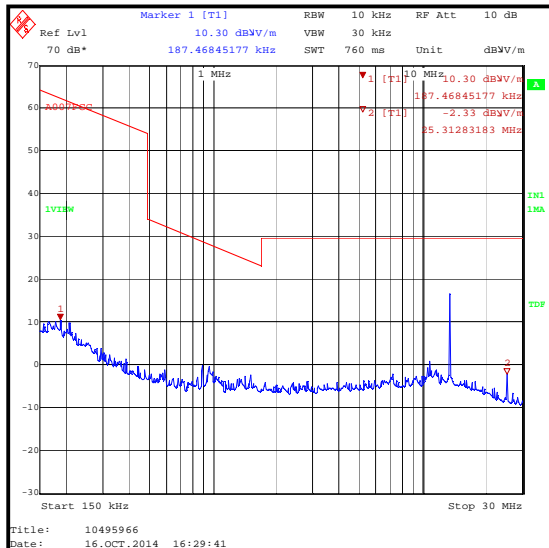


150 kHz to 490 kHz / average detector / EUT operating / measured at 30 metres on an open field test site

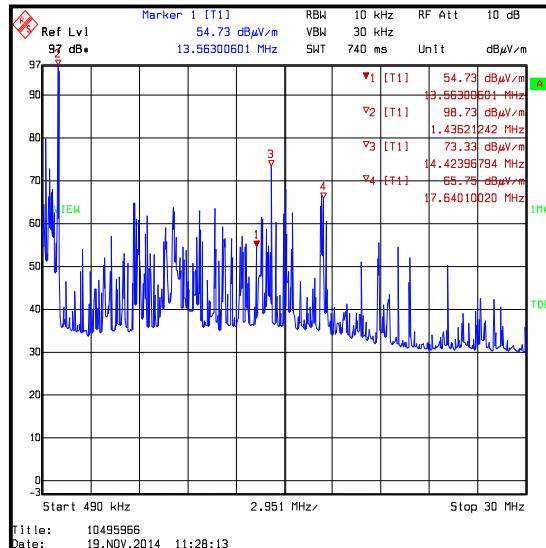


150 kHz to 490 kHz / average detector / EUT operating / measured at 300 metres on an open field test site

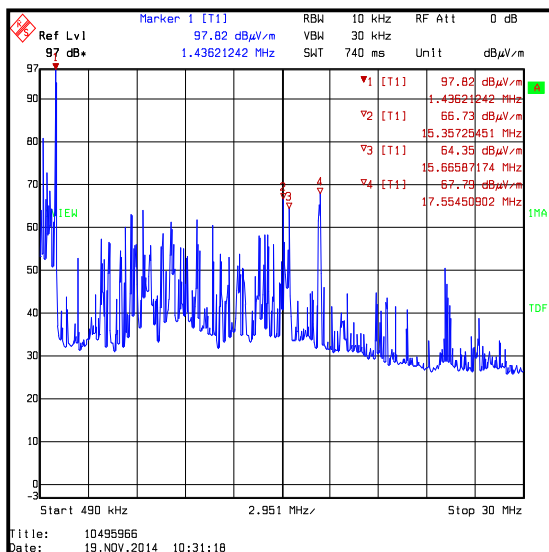
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying table.

Transmitter Radiated Spurious Emissions (continued)

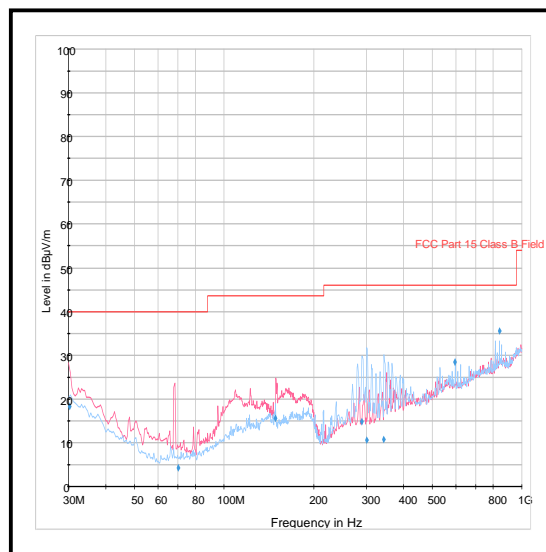
150 kHz to 30 MHz / peak detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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

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

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	30.5015.13	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 2014	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	26 Feb 2015	12
A490	Antenna	Chase	CBL6111A	1590	29 Apr 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
G0543	Amplifier	Sonoma	310N	230801	20 Nov 2014	3
A1834	Attenuator	Hewlett Packard	8491B	10444	15 Nov 2014	12

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

5.2.4. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Georgios Vrezas	Test Date:	16 October 2014
Test Sample Serial Number:	MAR003431UN14		

FCC Reference:	Parts 15.225(c)(d) & 15.209(a)
Test Method Used:	As detailed in ANSI C63.10 Section 6.9.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	37

Note(s):

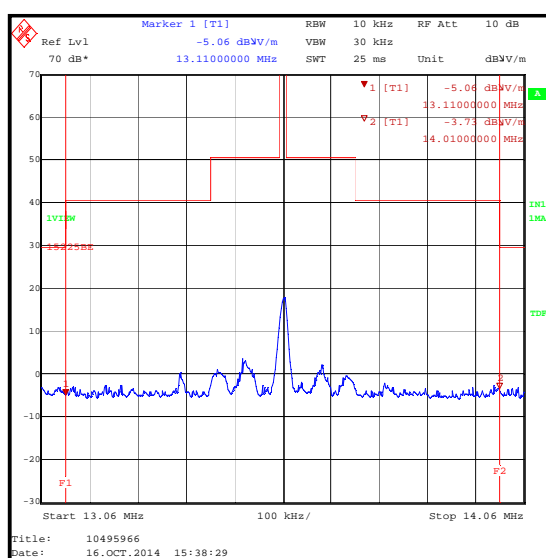
1. In accordance with FCC KDB 937606, a *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a). It was not possible to determine the band edge emission values at the test distances specified below 30 MHz on an open field test site due to the presence of ambient emissions, therefore in accordance with 47 CFR 15.31(f), measurements were made at closer distances. Attempts were made to measure the fundamental and band edges at 3 metres on an open field test site on 19 November. Unfortunately the emission could not be seen above the ambient emissions or the noise floor of the measurement system. Therefore the results from the semi-anechoic chamber tests on 16 October 2014 are shown in this section of the test report. Background scans of the open field test site are shown in Appendix 1 of this test report.
2. For the field strength measurements in a semi-anechoic chamber, a transducer factor on the measuring instrument was used to extrapolate the results at 3 metres to a distance of 30 metres where required. A distance extrapolation factor of 40 dB was used.

Transmitter Band Edge Radiated Emissions (continued)**Results: Quasi Peak Lower Band Edge**

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
13.11	-5.6	29.5	35.1	Complied

Results: Quasi Peak Upper Band Edge

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
14.01	-4.2	29.5	33.7	Complied

**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1622	Thermohygrometer	JM Handelspunkt	30.5015.06	None stated	31 Dec 2014	12
K0001	5m RSE Chamber	Rainford EMC	N/A	N/A	26 Nov 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

5.2.5. Transmitter Frequency Stability (Temperature & Voltage Variation)**Test Summary:**

Test Engineer:	Georgios Vrezas	Test Date:	22 October 2014
Test Sample Serial Number:	MAR003431UN14		

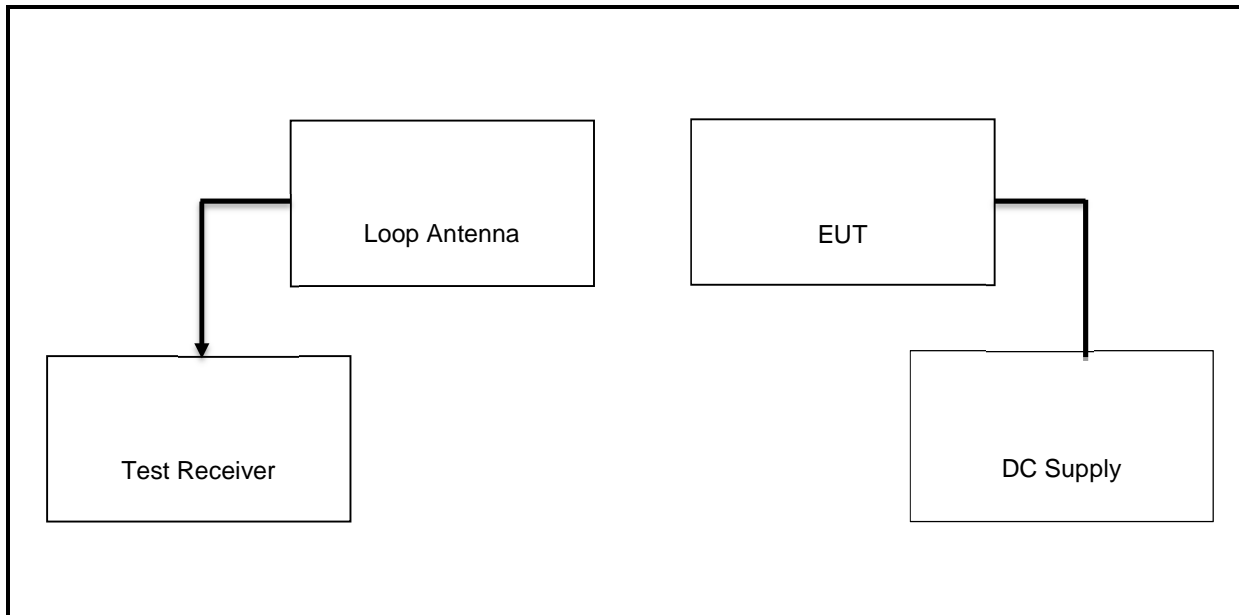
FCC Reference:	Part 15.225(e)
Test Method Used:	As detailed in ANSI C63.10 Section 6.8.1 and 6.8.2

Environmental Conditions:

Ambient Temperature (°C):	20
Ambient Relative Humidity (%):	35

Note(s):

1. Testing at voltage extremes was performed with the EUT powered by an external DC power supply. The EUT's battery was removed and the power supply was connected to the EUT's battery terminals. The manufacturer declared the minimum and maximum primary supply voltages as 3.6 and 4.2.
2. Frequency error was measured using a calibrated Rohde & Schwarz spectrum analyser.
3. Temperature was monitored throughout the test with a calibrated digital thermometer.
4. Voltage was monitored throughout the test with a calibrated digital voltmeter.

Test setup for Frequency Stability measurements:

Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)**Results: Maximum frequency error of the EUT with variations in ambient temperature**

Temperature (°C)	Time after Start-up			
	0 minutes	2 minutes	5 minutes	10 minutes
-20	13.560166	13.560170	13.560173	13.560175
20	13.560209	13.560210	13.560208	13.560209
50	13.560179	13.560178	13.560178	13.560177

Frequency with Worst Case Deviation (MHz)	Frequency Error (Hz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
13.560210	210	0.001549	0.01	0.008451	Complied

Results: Maximum frequency error of the EUT with variations in nominal operating voltage at an ambient temperature of 20°C

Supply Voltage (V)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (%)	Limit (%)	Margin (%)	Result
3.6	13.56	13.560237	237	0.001748	0.01	0.008252	Complied
3.7	13.56	13.560209	209	0.001541	0.01	0.008459	Complied
4.2	13.56	13.560339	339	0.002500	0.01	0.007500	Complied

Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)**Test Equipment Used:**

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M1658	Thermohygrometer	JM Handelspunkt	30.5015.13	None stated	14 Mar 2015	12-
E013	Environmental Chamber	Sanyo	MTH-4200PR	None stated	Calibrated before use	-
M1269	Multimeter	Fluke	179	90250210	19 May 2015	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB30	842659/016	30 Sep 2015	12
S0557	DC Power Supply	TTi	EL303R	395819	Calibrated before use	-

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
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Transmitter Fundamental Field Strength	13 MHz to 14 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
Frequency Stability	13 MHz to 14 MHz	95%	±0.92 ppm

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

8. Appendix 1

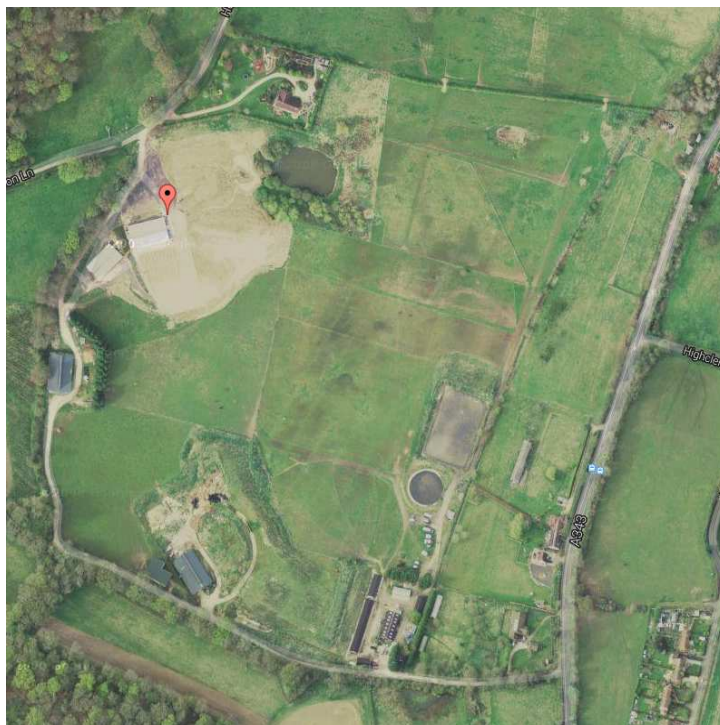
Details of 3 metre and 30 metre open field test site used on 19 November 2014

GPS coordinates: 51.334017,-1.384317

Temperature: 5°C to 10°C

Relative Humidity: 70% to 99%

Ground conditions: Wet



Arial view of test site. Red marker indicates test location

Measurements at 3 and 30 metres

The test site was free from underground metal objects.

The EUT was powered at its nominal voltage from its internal battery. The USB cable was inserted and connected to the USB charger. The USB charger was connected to a single phase supply. A power cable was run across the site to the EUT via the USB charger and associated USB cable. An RCD was fitted to the power source.

The EUT was placed on a plastic table at a height of 0.8 metres above ground level. All associated cables and support equipment were arranged according to ANSI C63.4-2009 Section 6.

The spectrum analyser used for measurements was located in a vehicle 30 metres from the magnetic loop antenna. Power to the test equipment was from a single phase supply.

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.

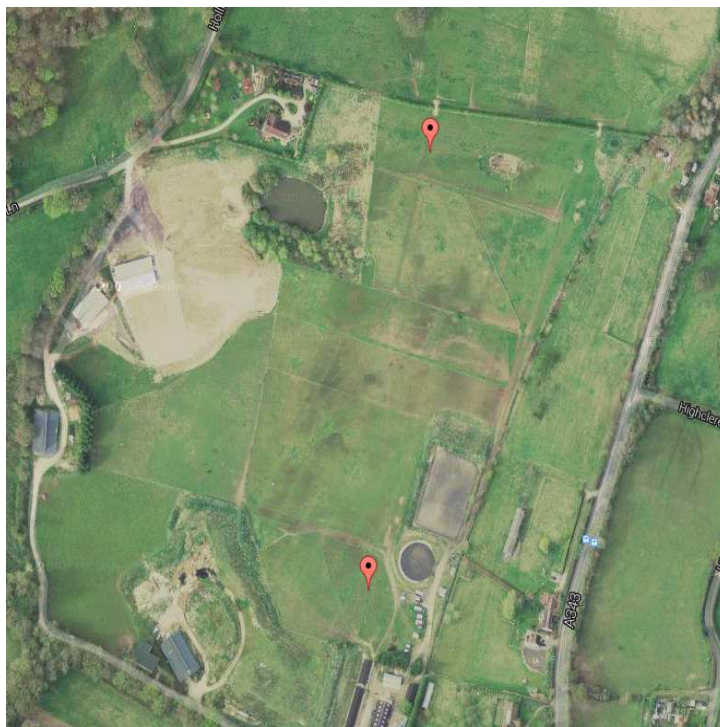
Details of 300 metre open field test site used on 06 November 2014

GPS coordinates: 51.331867,-1.381833 (mag loop antenna / lower marker) and 51.334667,-1.381117 (EUT / upper marker)

Temperature: 5°C to 11°C

Relative Humidity: 72% to 99%

Ground conditions: Wet



**Aerial view of test site. Red markers indicates test locations.
EUT located at upper marker. Mag loop antenna located at lower marker.**



**Set up for 300 metre measurements
(mag loop end, orange in distance is EUT location)**

Measurements at 300 metres

The test site was free from underground metal objects.

The EUT was powered at its nominal voltage from its internal battery. The USB cable was inserted and connected to the USB charger. The USB charger was connected to a single phase supply from a portable generator. A power cable was run across the field to the USB charger. An RCD was fitted to the power source. The generator was located 50 metres from the EUT and surrounded by radio absorbent material. For safety purposes, an RCD was fitted to the generator output.

The EUT was placed on a plastic table at a height of 0.8 metres above ground level. All associated cables were arranged according to ANSI C63.4-2009 Section 6.

The spectrum analyser used for measurements was located in a vehicle 30 metres from the magnetic loop antenna. Power to the test equipment was from a single phase agricultural supply.

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.

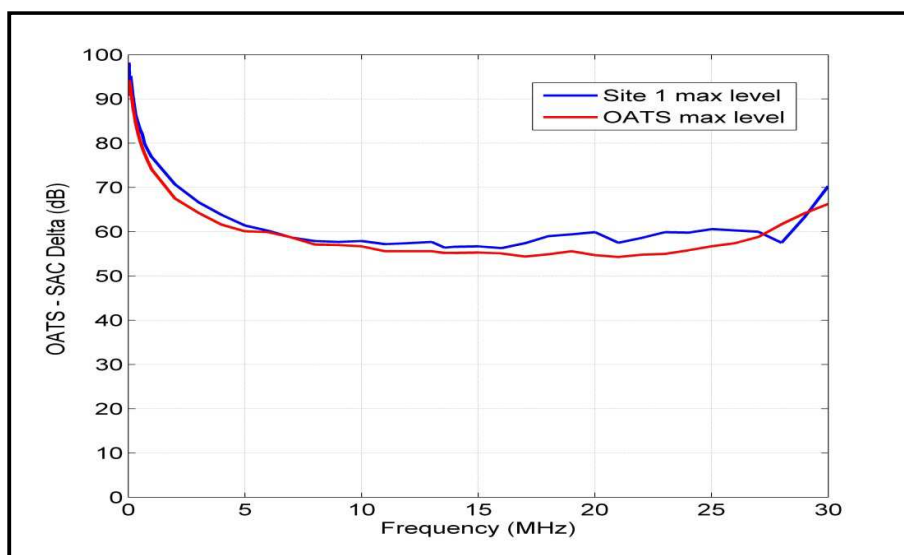
The EUT was rotated through 360 degrees in 60 degree steps. The mag loop antenna was rotated through 90 degrees in 30 degree steps at every position the EUT was moved to.

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

Radiated measurements were performed on 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.

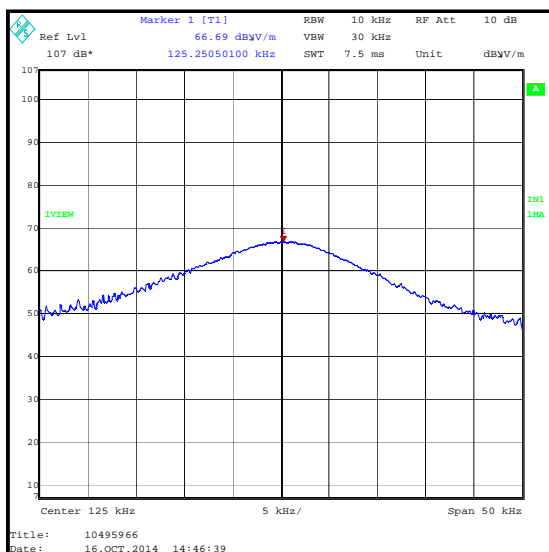
The centre of the magnetic loop antenna is placed exactly 3 metres from the reference unit. The reference unit is placed on a plastic table at a height of 0.8 metres above floor level and the centre of the mag loop antenna is 1 metre above the floor level. The mag loop antenna and reference unit are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

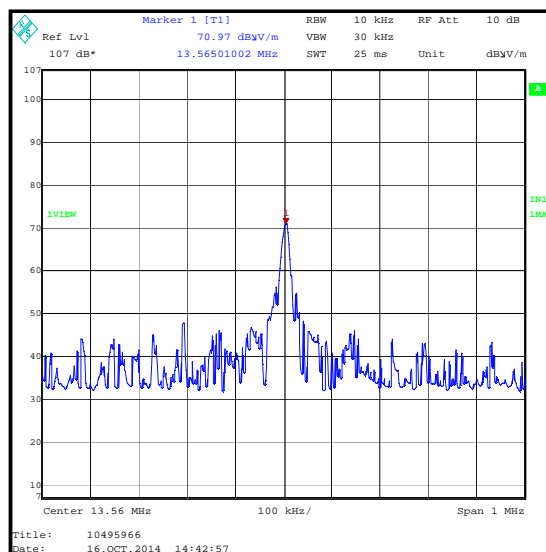
The internal verification procedure and verification plots are available for inspection on request.

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

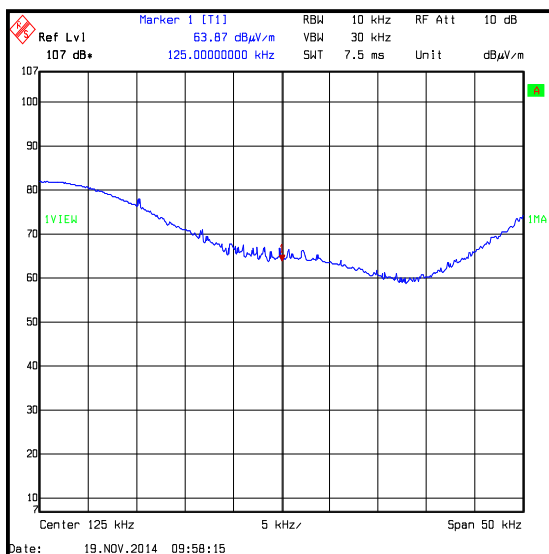
Verification plots of the two reference units at a measurement distance of 3 metres are shown on the following page. Plots were taken on an open field test site (19 November 2014) and in a semi-anechoic chamber (16 October 2014).



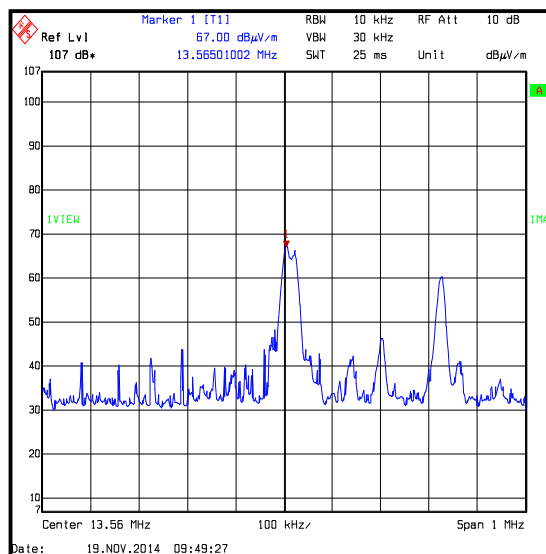
125 kHz reference unit signal at 3 metres in a semi-anechoic chamber on 16 October 2014



13.56 MHz reference unit signal at 3 metres in a semi-anechoic chamber on 16 October 2014



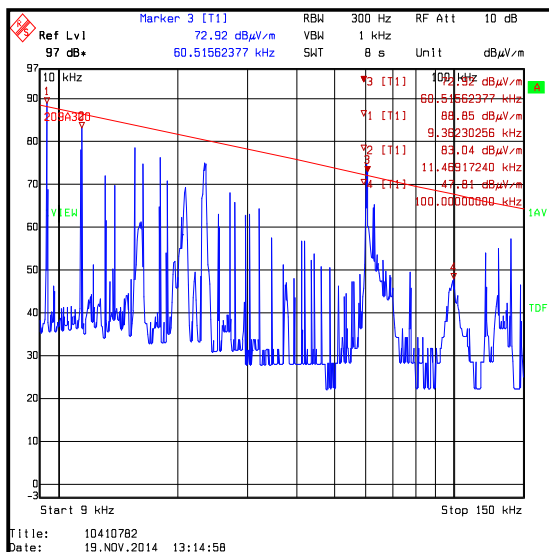
125 kHz reference unit signal at 3 metres on an open field test site on 19 November 2014



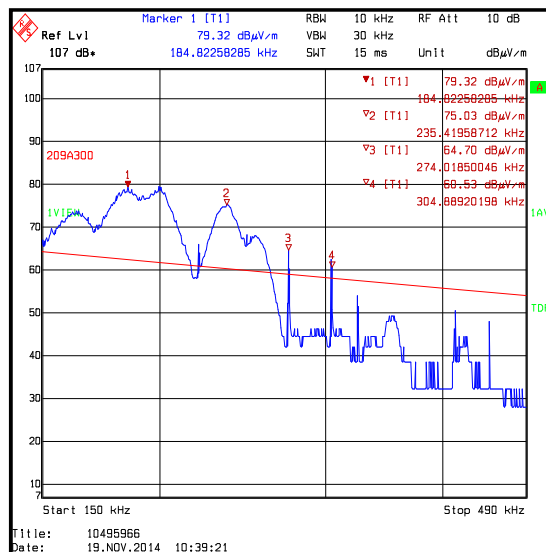
13.56 MHz reference unit signal at 3 metres on an open field test site on 19 November 2014

Note(s):

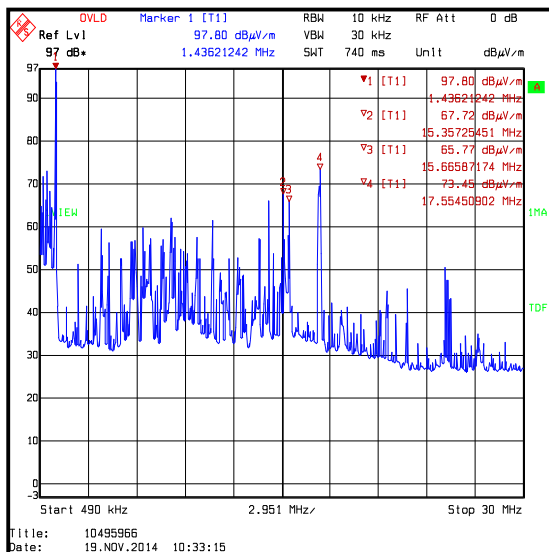
1. The above plots show comparable measurements of reference units on an open field test site and in a semi-anechoic chamber at spot frequencies.

Background scans of the open field test site

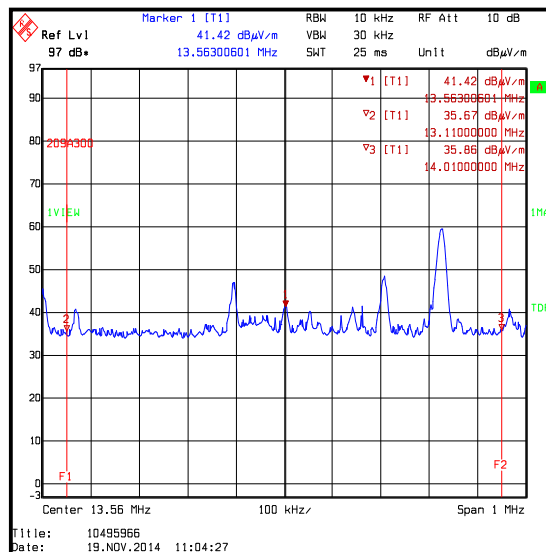
**Frequency range: 9 kHz to 150 kHz
Average detector / background scan**



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



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



**Frequency range: 13.06 MHz to 14.06 MHz
/ background scan of the open field test site**

Note(s):

1. The above plots are background scans of the open field test site. The EUT and generator (when used) were 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.

--- END OF REPORT ---