TEST REPORT

Test Report No. : UL-RPT-RP11888510-416A V3.0

Manufacturer	:	Paxton Access Ltd
Model Name / PMN	:	Paxton10 Reader Keypad
HVIN	:	010-721
FCC ID	:	USE010721
ISED Certification No.	:	IC: 10217A-010721
Test Standard(s)	:	FCC Parts 15.207 & 15.209; ISED Canada RSS-Gen 6.6, 6.12, 6.13, 8.8 & 8.9

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: 21 February 2018

Checked by:

Ian Watch
Senior Test Engineer, Radio Laboratory

Company Signatory:

Sarah Williams
Senior Test Engineer, Radio Laboratory
UL VS LTD

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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:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209
Specification Reference:	RSS-Gen Issue 4, November 13, 2014
Specification Title:	General Requirements for Compliance of Radio Apparatus
Site Registration:	FCC: 209735; ISED Canada: 3245B-2
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	20 December 2017 to 18 January 2018

2.2. Summary of Test Results

FCC Reference (47CFR)	ISED Canada Reference	Measurement	Result
Part 15.207	RSS-Gen 8.8	Transmitter AC Conducted Emissions	✓
Part 15.209	RSS-Gen 6.12 & 8.9	Transmitter Fundamental Field Strength	✓
Part 15.209	RSS-Gen 6.13 & 8.9	Transmitter Radiated Emissions	✓
N/A	RSS-Gen 6.6	Transmitter 99% Occupied Bandwidth	✓

Key to Results

✓ = Complied ✗ = Did not comply

2.3. Methods and Procedures

Reference:	ANSI C63.4-2013
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 C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	FCC KDB Publication Number 414788 Date: 18 April 2017
Title:	TEST SITES FOR RADIATED EMISSION MEASUREMENTS
Reference:	KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

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:	Paxton10
Model Name / PMN:	Paxton10 Reader Keypad
HVIN:	010-721
Test Sample Serial Number:	Marked as '125 kHz TX mode sample'
Hardware Version:	Rev D, z-n051k Rev 5, z-n053 Rev 3
Software Version:	2.07.6540.30069
FCC ID:	USE010721
ISED Canada Certification Number:	IC: 10217A-010721

3.2. Description of EUT

The Equipment Under Test was a keypad reader for a door entry system. It contains 125 kHz and 13.56 MHz transmitters. The antenna is integral.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Type of Radio Device:	Transmitter	
Power Supply Requirement(s):	120 VAC 60 Hz	
Transmit Frequency Range:	125 kHz	
Transmit Channel Tested:	**Channel ID**	**Channel Frequency (kHz)**
	Single channel	125

3.5. Support Equipment

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

Description:	Paxton10
Brand Name:	Paxton10 controller
Model Name or Number:	010-121
Serial Number:	2934419
Hardware Version:	Rev C
Software Version:	2.07.6540.30069

Description:	Paxton10
Brand Name:	Paxton10 door connector
Model Name or Number:	010-519
Serial Number:	3652604
Hardware Version:	Rev C
Software Version:	Not marked or stated

Description:	PoE Injector
Brand Name:	Phihong
Model Name or Number:	POE-31U-1AT

Description:	Ethernet router
Brand Name:	TP Link
Model Name or Number:	TL-WR84XX

Description:	Ethernet cable. Length 0.5 metres
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

Description:	Ethernet cable. Length 1.0 metre. Quantity 2.
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude D610

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

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

- Transmitting with a modulated carrier in RFID test mode.

4.2. Configuration and Peripherals

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

- The EUT and support equipment was configured following customer's test mode instructions 'Paxton10 Keypad reader – test set-up for radio testing'.
- The EUT started transmitting as soon as it was connected to the Paxton10 Controller.
- The support equipment was placed in a screened box away from the EUT during final radiated emission measurements.
- The Paxton10 system was powered from a PoE injector connected to an AC mains supply during all tests.

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 AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Ian Watch & Victor Carmon	**Test Date:**	13 January 2018
Test Sample Serial Number:	125 kHz Tx Mode Sample		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 and Notes below

Environmental Conditions:

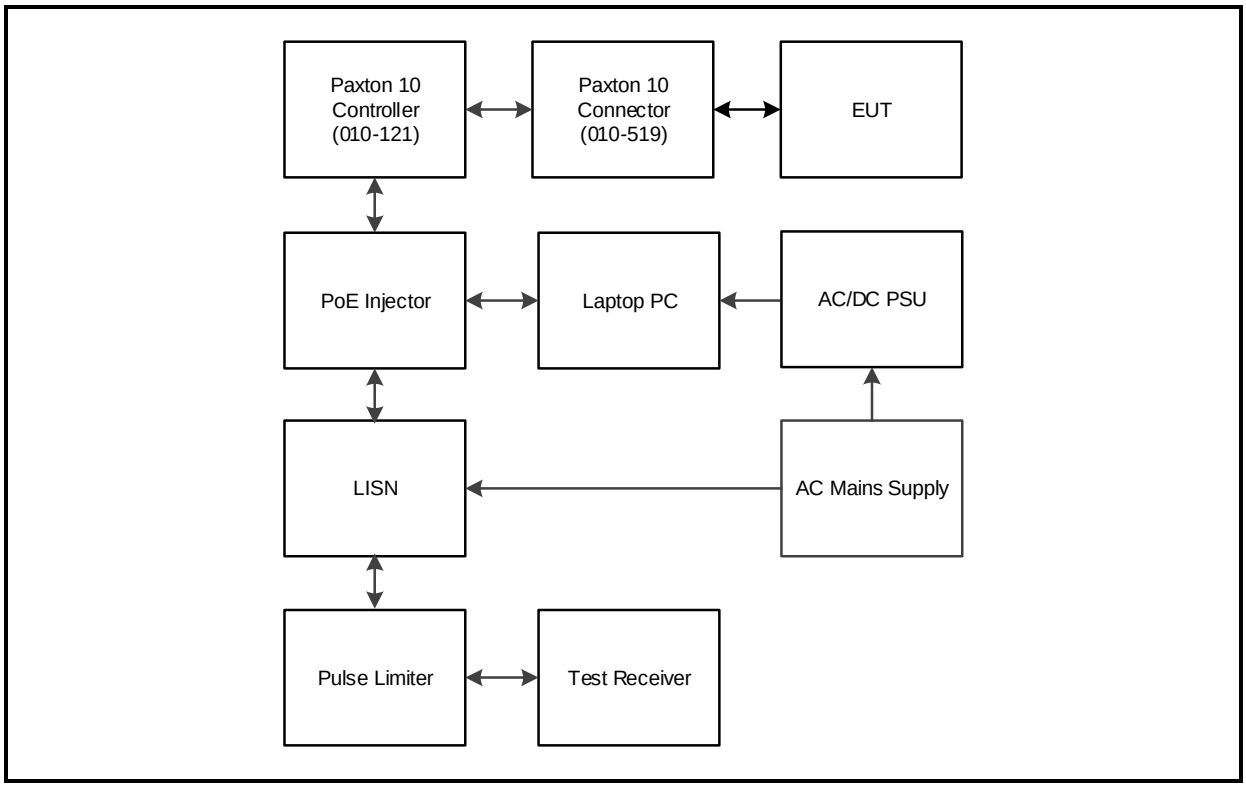
Temperature (°C):	20 to 21
Relative Humidity (%):	36 to 39

Note(s):

1. The EUT was connected to a 120 VAC 60 Hz single phase supply single phase supply via a LISN.
2. A pulse limiter was fitted between the LISN and the test receiver.
3. Pre-scans were performed and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
4. In accordance with FCC KDB 174176 Q4, tests were also performed with a 240 VAC 60 Hz single phase supply as this was within the voltage range marked on the PoE supply for the Paxton10 system.

Transmitter AC Conducted Spurious Emissions (continued)

Test setup:



Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.168000	Live	44.6	65.1	20.5	Complied
0.267000	Live	40.9	61.2	20.3	Complied
0.402000	Live	39.1	57.8	18.7	Complied
0.667500	Live	34.9	56.0	21.1	Complied
2.679000	Live	40.1	56.0	15.9	Complied
21.174000	Live	44.4	60.0	15.6	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.267000	Live	37.8	51.2	13.4	Complied
0.402000	Live	37.0	47.8	10.8	Complied
0.672000	Live	34.3	46.0	11.7	Complied
1.207500	Live	30.5	46.0	15.5	Complied
2.679000	Live	39.7	46.0	6.3	Complied
21.169500	Live	42.7	50.0	7.3	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

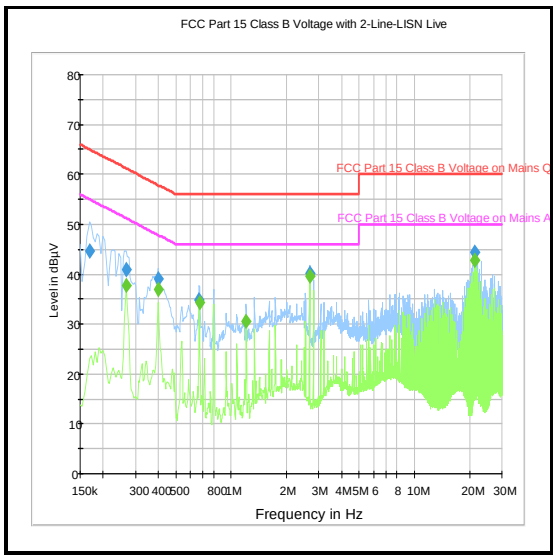
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.177000	Neutral	45.7	64.6	18.9	Complied
0.267000	Neutral	41.4	61.2	19.8	Complied
0.402000	Neutral	39.9	57.8	18.0	Complied
0.672000	Neutral	36.2	56.0	19.8	Complied
2.679000	Neutral	40.1	56.0	15.9	Complied
21.174000	Neutral	42.6	60.0	17.4	Complied

Results: Neutral / Average / 120 VAC 60 Hz

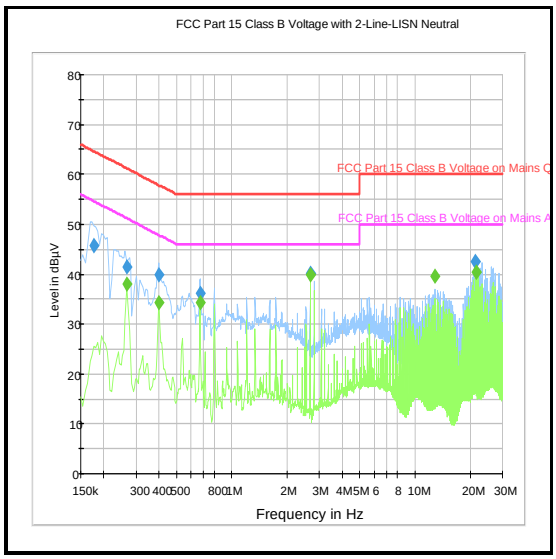
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.267000	Neutral	37.9	51.2	13.3	Complied
0.402000	Neutral	34.4	47.8	13.4	Complied
0.672000	Neutral	34.4	46.0	11.6	Complied
2.679000	Neutral	39.8	46.0	6.2	Complied
12.862500	Neutral	39.5	50.0	10.5	Complied
21.574500	Neutral	40.5	50.0	9.5	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 120 VAC 60 Hz



Live



Neutral

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

Transmitter AC Conducted Spurious Emissions (continued)

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.168000	Live	40.5	65.1	24.6	Complied
0.402000	Live	42.4	57.8	15.4	Complied
0.672000	Live	35.3	56.0	20.7	Complied
1.207500	Live	34.7	56.0	21.3	Complied
2.679000	Live	40.0	56.0	16.0	Complied
21.174000	Live	43.5	60.0	16.5	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.267000	Live	37.8	51.2	13.4	Complied
0.402000	Live	35.2	47.8	12.6	Complied
0.672000	Live	34.2	46.0	11.8	Complied
1.207500	Live	33.6	46.0	12.4	Complied
2.679000	Live	39.5	46.0	6.5	Complied
21.169500	Live	41.2	50.0	8.8	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

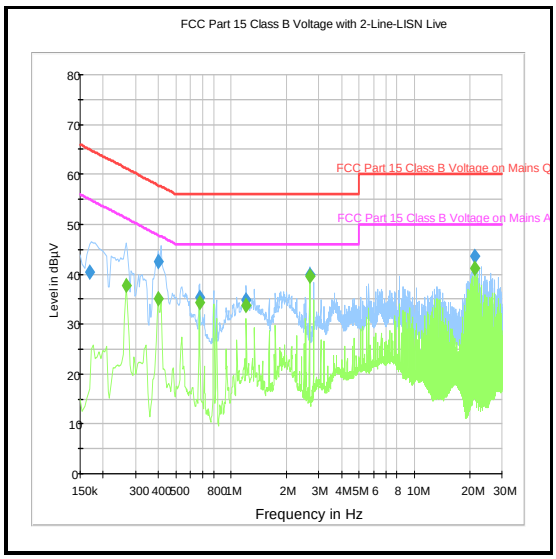
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.172500	Neutral	41.5	64.8	23.3	Complied
0.271500	Neutral	40.7	61.1	20.4	Complied
0.402000	Neutral	43.3	57.8	14.5	Complied
1.207500	Neutral	35.3	56.0	20.7	Complied
2.679000	Neutral	40.0	56.0	16.0	Complied
21.174000	Neutral	42.2	60.0	17.8	Complied

Results: Neutral / Average / 240 VAC 60 Hz

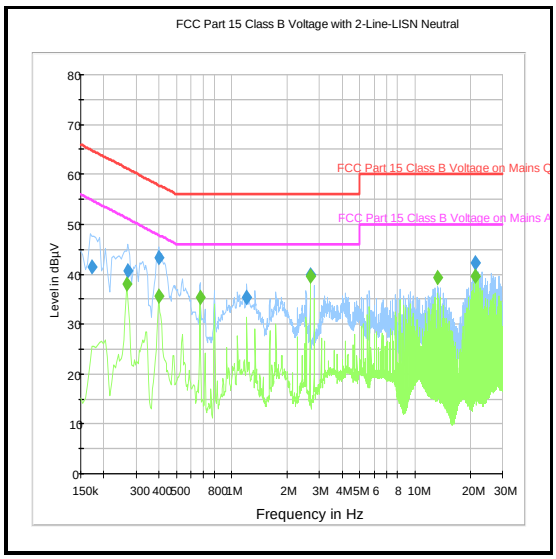
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.267000	Neutral	38.0	51.2	13.2	Complied
0.402000	Neutral	35.6	47.8	12.2	Complied
0.672000	Neutral	35.3	46.0	10.7	Complied
2.679000	Neutral	39.6	46.0	6.4	Complied
13.267500	Neutral	39.3	50.0	10.7	Complied
21.169500	Neutral	39.6	50.0	10.4	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: 240 VAC 60 Hz



Live



Neutral

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)
M2013	Thermohygrometer	Testo	608-H1	45066419	20 Jun 2018	12
A649	LISN	Rohde & Schwarz	ESH3-Z5	825562/008	31 May 2018	12
A1830	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100668	09 May 2018	12
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	13 Nov 2018	12

5.2.2. Transmitter Fundamental Field Strength

Test Summary:

Test Engineer:	Ian Watch	**Test Date:**	21 December 2017
Test Sample Serial Number:	125 kHz TX mode sample		

FCC Reference:	Part 15.209(d)
ISED Canada Reference:	RSS-Gen 6.12 & 8.9
Test Method Used:	ANSI C63.4 Section 6.4, Notes below and Appendix 1

Environmental Conditions:

Temperature (°C):	9
Relative Humidity (%):	87

Note(s):

1. A *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a) and RSS-Gen Section 8.9. 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) and ISED Canada RSS-Gen 6.4, measurements were made at closer distances. Attempts were made to measure the fundamental at 300 and 30 metres on an open field test site on 21 December 2017. The test was repeated at a distance of 3 metres and the fundamental was visible at this distance.
2. The limit is specified at a test distance of 300 metres. However, as specified by FCC Part 15.31(f)(2) and ISED Canada RSS-Gen 6.4, 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). A maximum level of 62.4 dBµV/m at a measurement distance of 3 metres was recorded. This was extrapolated to a distance of 300 metres by subtracting 80 dB (two decades):

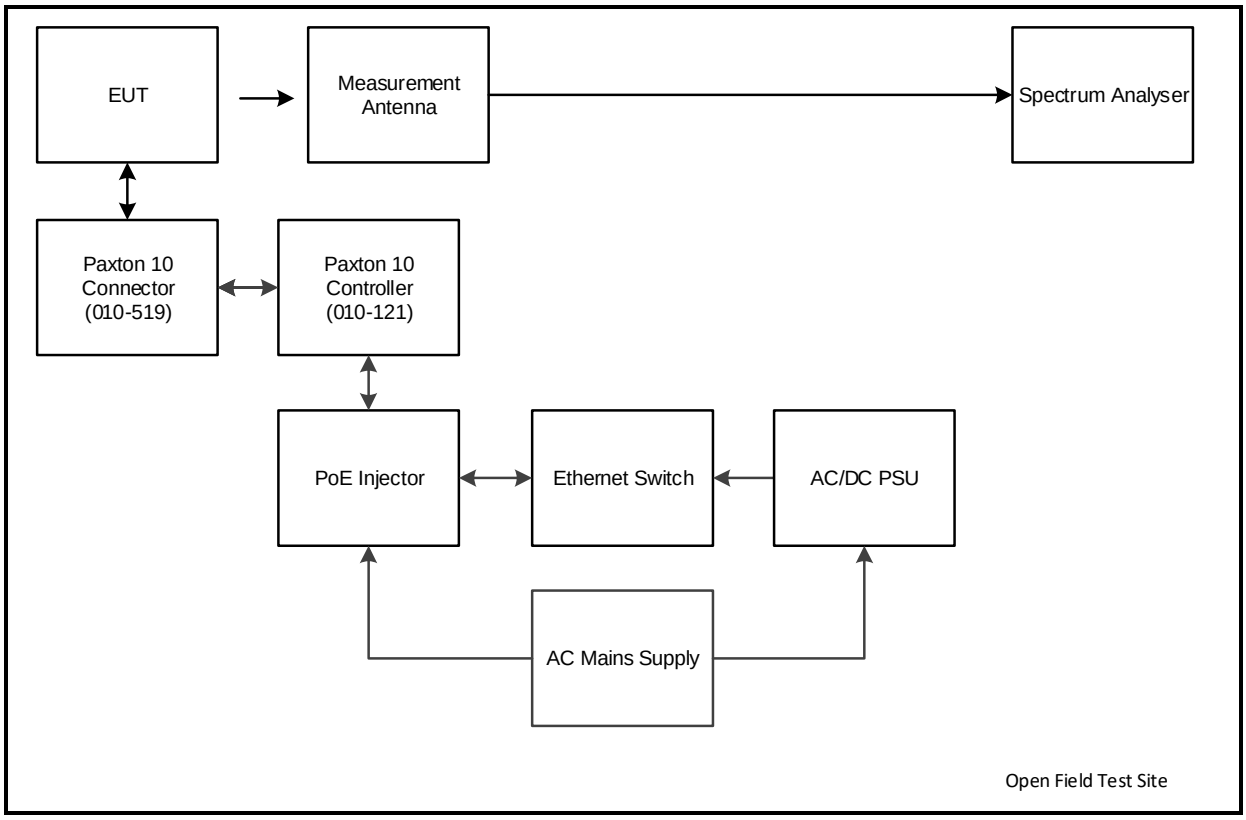
   $$62.4 - 80 = -17.6\ dB\mu V/m$$

3. 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.
4. Measurements were performed with an average detector as stated in FCC Part 15.209(d) and ISED Canada RSS-Gen 8.9 Table 5.
5. All other emissions shown on the result plot are ambient emissions present on the open field test site.

Transmitter Fundamental Field Strength (continued)

Test setup for fundamental field strength measurements:

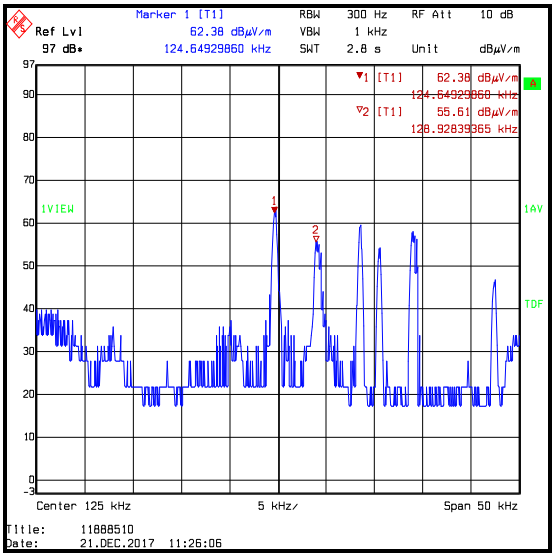
Measurements on an Open Field Test Site



Transmitter Fundamental Field Strength (continued)

Results: Average

Frequency (kHz)	Measurement Antenna Position	Level at 300 m (dBµV/m)	Limit at 300 m (dBµV/m)	Margin (dB)	Result
125	Tip 90° to EUT	-17.6	25.7	43.3	Complied



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2016	Thermohygrometer	Testo	608-H1	45046428	22 Feb 2018	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	08 May 2018	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB	842659/016	01 Dec 2018	12
M1956	Precision Steel Rule	Rabone	(64SR) 0-35-406	4501361/2204	22 Apr 2020	60
A2686	Distance Measuring Wheel	Rolson	50799	Not stated	Calibrated before use	-
A2955	Protractor	Not marked or stated	9781907550980	#1	Calibration not required	-

5.2.3. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineers:	Ian Watch & Victor Carmon	**Test Dates:**	20 December 2017 to 11 January 2018
Test Sample Serial Number:	125 kHz Tx Mode Sample		

FCC Reference:	Part 15.209
ISED Canada Reference:	RSS-Gen 6.13 & 8.9
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):	9 to 22
Relative Humidity (%):	37 to 87

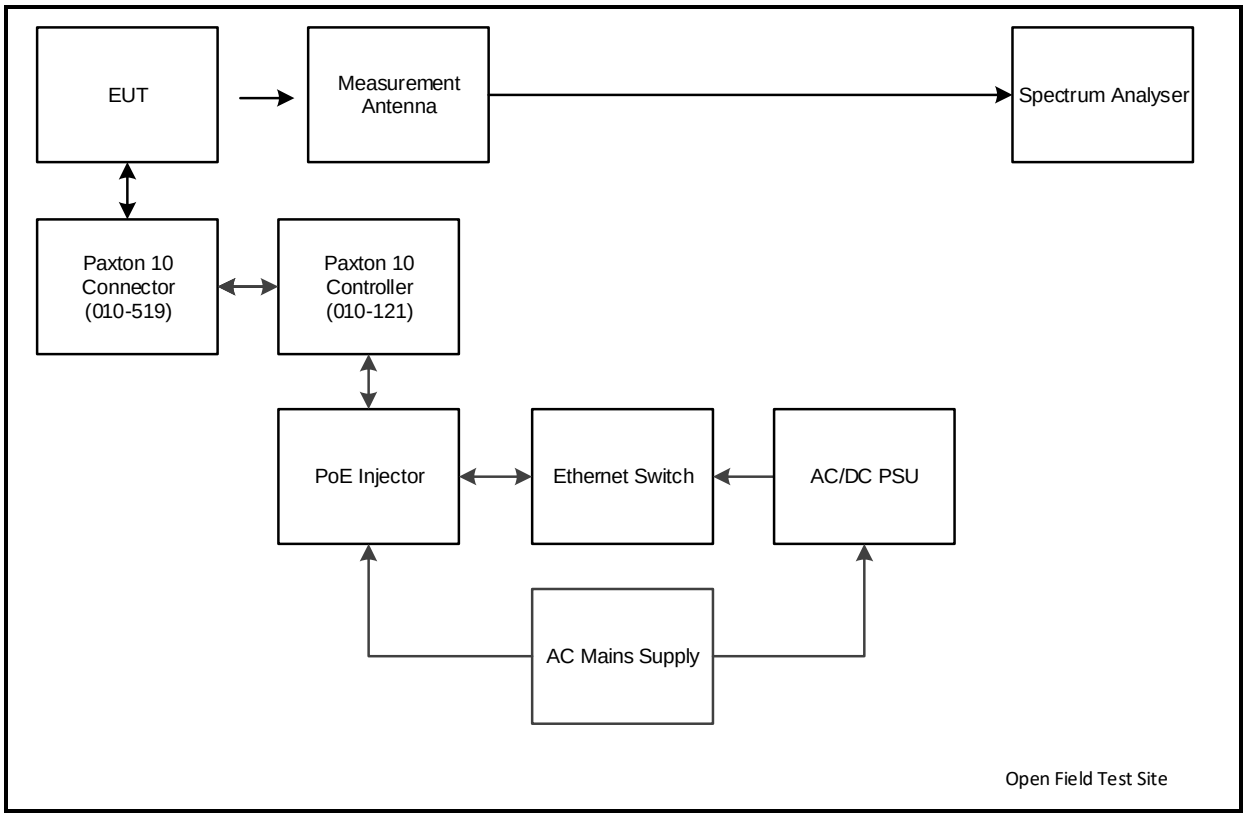
Note(s):

1. A *bona fide* attempt was made to perform measurements at the distances specified in Part 15.209(a) / RSS Gen Section 8.9 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) & RSS-Gen Section 6., 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 20 December 2017 and 21 December 2017. Final measurement results from the semi-anechoic chamber tests on 03 January 2018 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 emissions, in the table below incorporates the calibrated antenna factor and cable loss. Only final measurements for spurious emissions in the range 30 MHz to 1 GHz were recorded. Markers were placed on the peaks of the pre-scan plot and final measurements were performed using a quasi-peak detector. Measurements between 30 MHz and 1 GHz were initially made with the EUT and support equipment placed at a height of 0.8 metres above the test chamber floor. Radiated emissions from the support equipment were observed and further testing, including final measurements, were performed with the support equipment placed outside the test chamber.
3. 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.
4. 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.
5. 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)

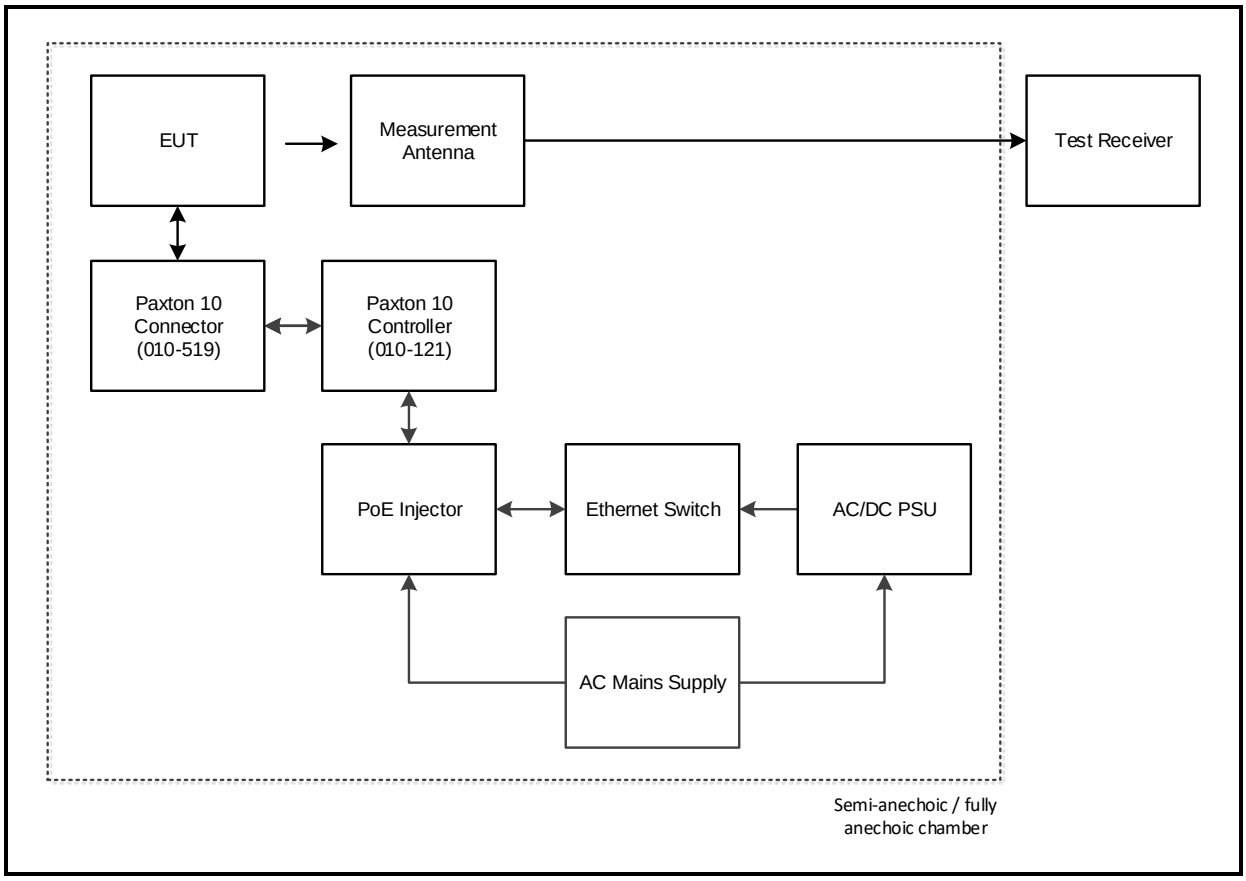
Test setup for radiated measurements:

Measurements on an Open Field Test Site



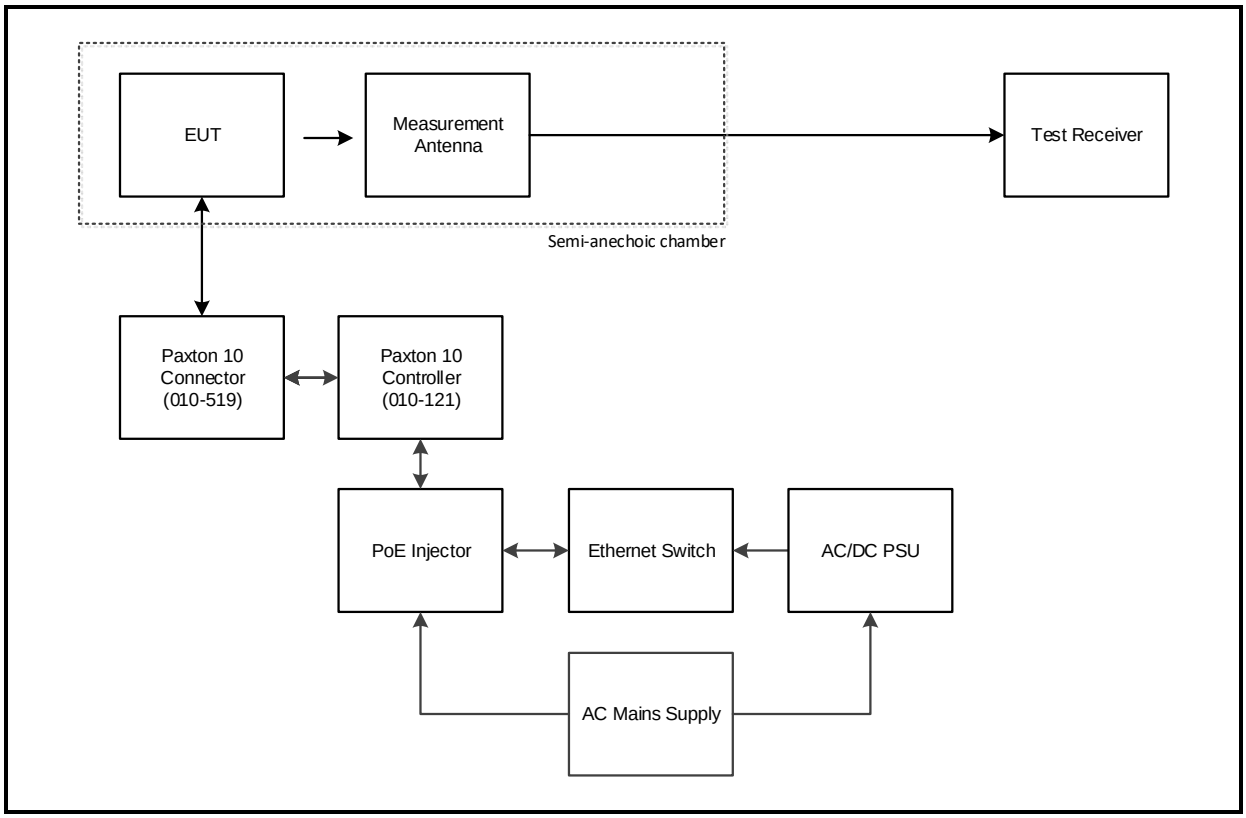
Transmitter Radiated Spurious Emissions (continued)

Measurements below 30 MHz in a semi-anechoic chamber



Transmitter Radiated Spurious Emissions (continued)

Measurements above 30 MHz in a semi-anechoic chamber

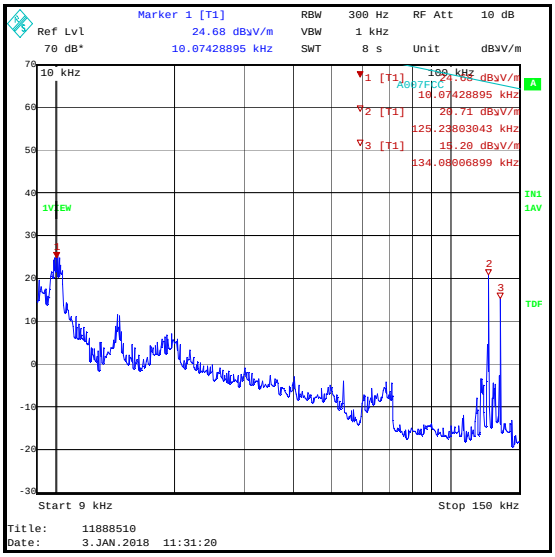


Transmitter Radiated Spurious Emissions (continued)

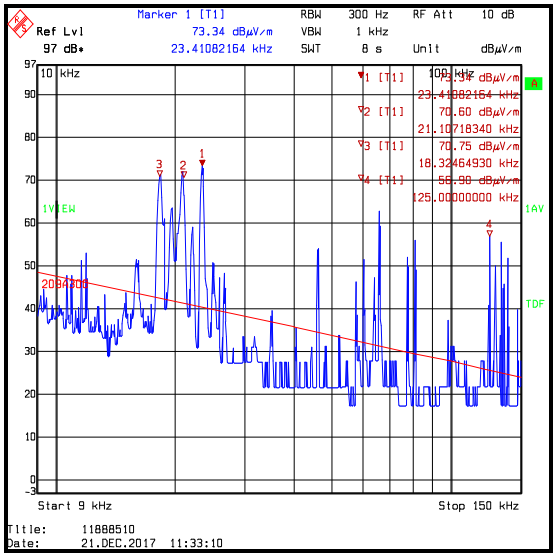
Results: Quasi Peak

Frequency (MHz)	Antenna Polarity	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
59.926	Vertical	23.2	40.0	16.8	Complied
83.002	Vertical	26.6	40.0	13.4	Complied
86.988	Vertical	27.0	40.0	13.0	Complied
100.416	Vertical	30.4	43.5	13.1	Complied
133.239	Vertical	16.9	43.5	26.6	Complied
212.749	Horizontal	13.4	43.5	30.1	Complied

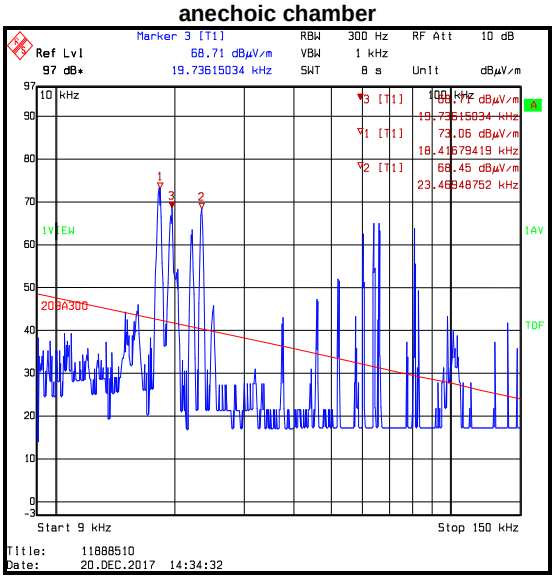
Transmitter Radiated Spurious Emissions (continued)



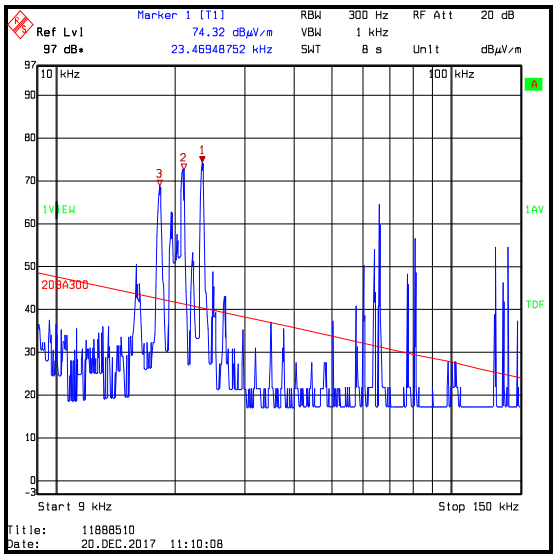
9 kHz to 150 kHz / average detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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



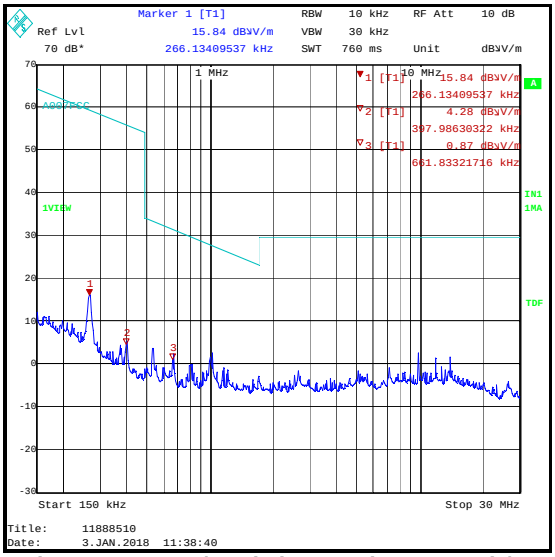
9 kHz to 150 kHz / average detector / EUT operating / measured at 30 metres on an open field test site



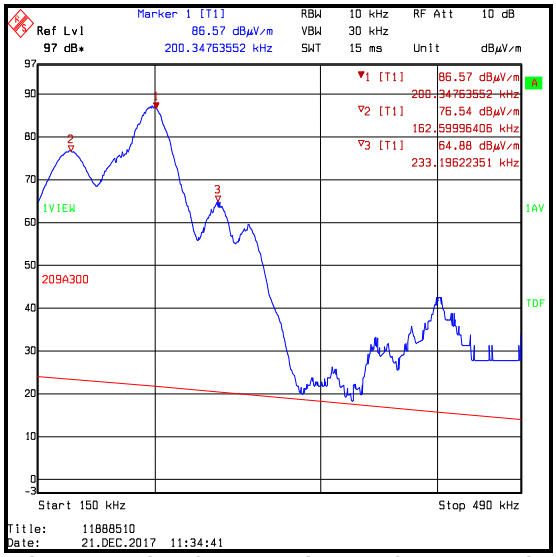
9 kHz to 150 kHz / average detector / EUT operating / measured at 300 metres on an open field test site

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

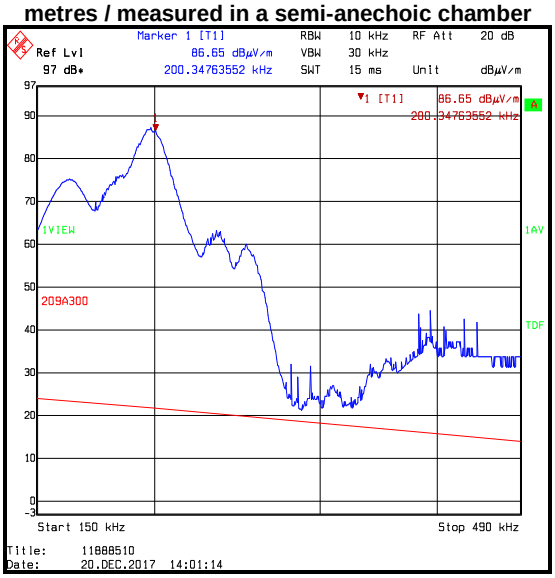
Transmitter Radiated Spurious Emissions (continued)



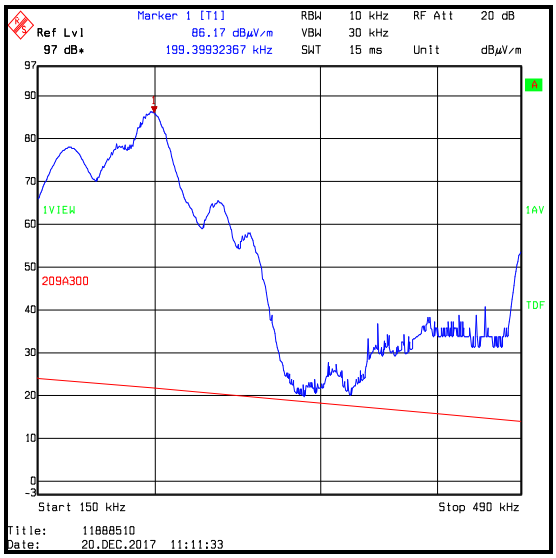
150 kHz to 30 MHz / peak detector (worst case) / EUT operating / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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



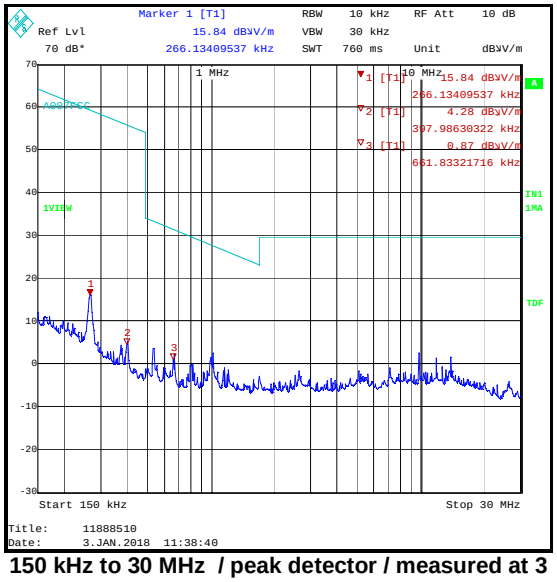
150 kHz to 490 kHz / average detector / EUT operating / measured at 30 metres on an open field test site



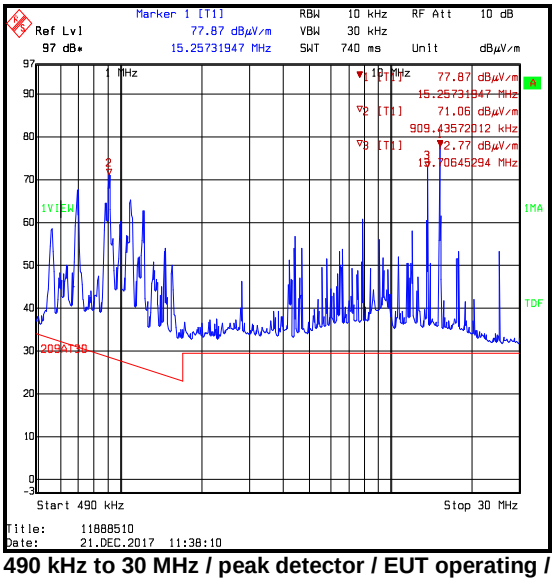
150 kHz to 490 kHz / average detector / EUT operating / measured at 300 metres on an open field test site

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

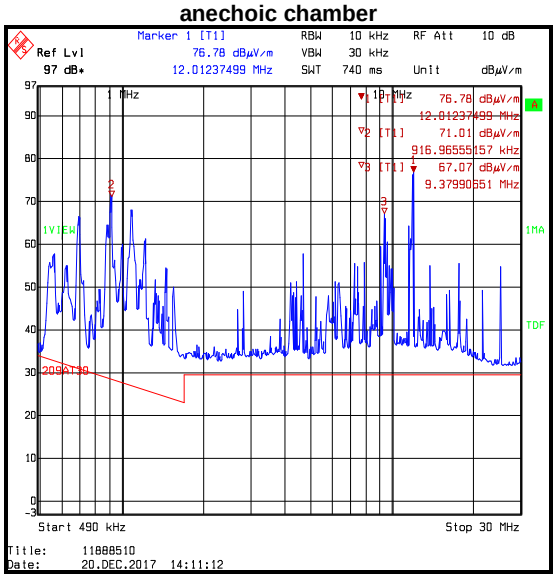
Transmitter Radiated Spurious Emissions (continued)



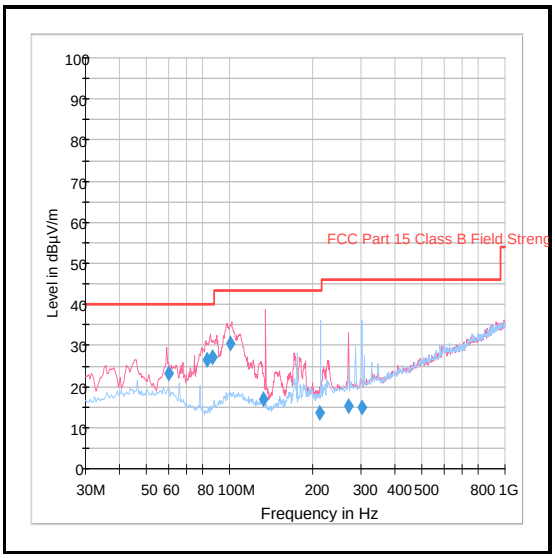
150 kHz to 30 MHz / peak detector / measured at 3 metres extrapolated to 30 metres / measured in a semi-anechoic chamber



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)
M2016	Thermohygrometer	Testo	608-H1	45046428	22 Feb 2018	12
M2009	Thermohygrometer	Testo	608-H1	45046699	20 Jun 2018	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	08 May 2018	12
A1834	Attenuator	Hewlett Packard	8491B	104444	23 Feb 2018	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB	842659/016	01 Dec 2018	12
A2959	Antenna	Schwatzbeck	VULB 9163	9613-967	16 Nov 2018	12
G0543	Preamplifier	Sonama	310N	230801	15 Jun 2018	12
M1273	Test Receiver	Rohde & Schwarz	ESIB26	100275	20 Apr 2018	12
M1956	Precision Steel Rule	Rabone	(64SR) 0-35-406	4501361/2204	22 Apr 2020	60
A2686	Distance Measuring Wheel	Rolson	50799	Not stated	Calibrated before use	-
A2955	Protractor	Not marked or stated	9781907550980	#1	Calibration not required	-
K0001	Semi-Anechoic Chamber	Rainford EMC	N/A	N/A	31 Jan 2018	12
M2009	Thermohygrometer	Testo	608-H1	45046699	20 Jun 2018	12

5.2.4. Transmitter 99% Occupied Bandwidth

Test Summary:

Test Engineers:	Ian Watch & Victor Carmon	**Test Date:**	18 January 2018
Test Sample Serial Number:	125 kHz Tx Mode Sample		

FCC Reference:	N/A
ISED Canada Reference:	RSS-Gen 6.6
Test Method Used:	ANSI C63.10 Section 6.9.2

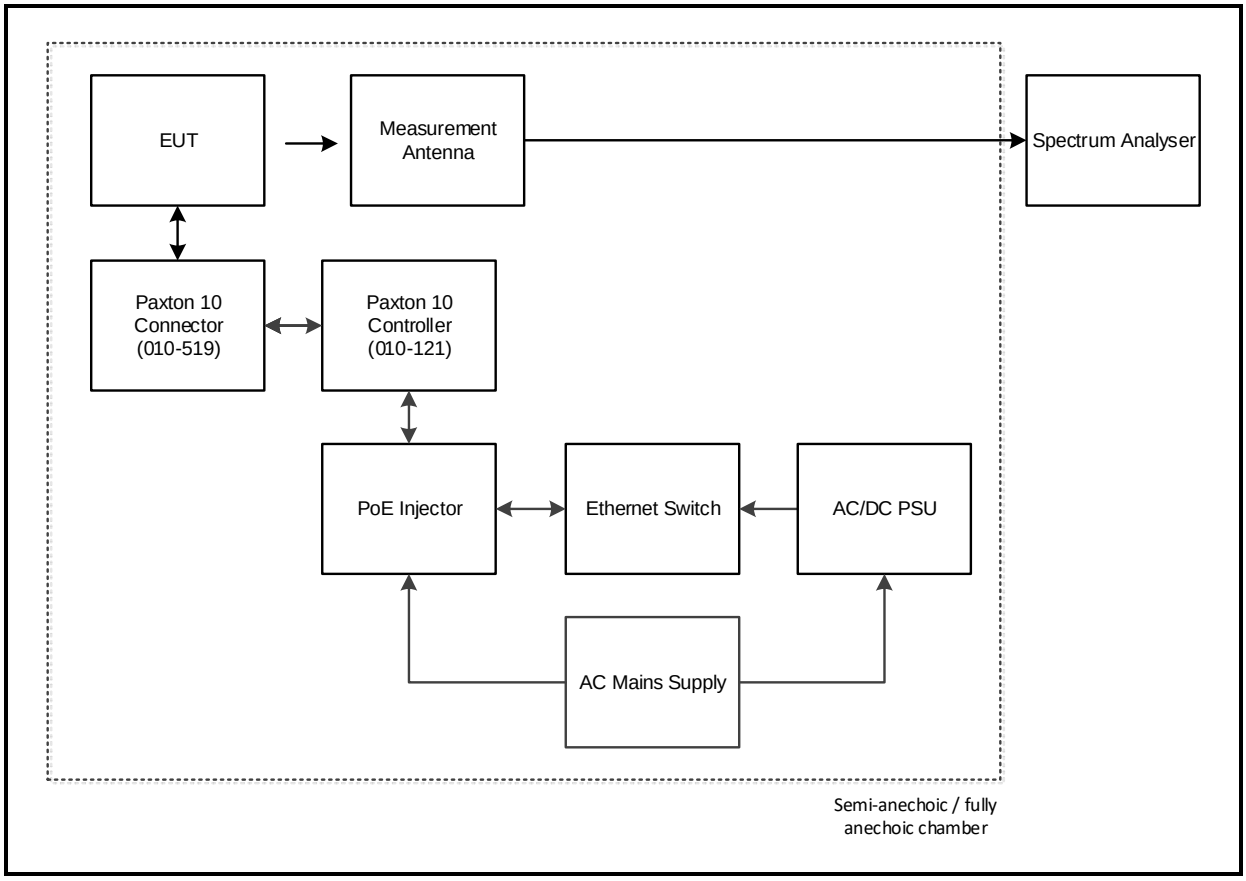
Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	35

Note(s):

1. 99% Occupied bandwidth was measured using the 99% occupied bandwidth function of a spectrum analyser.

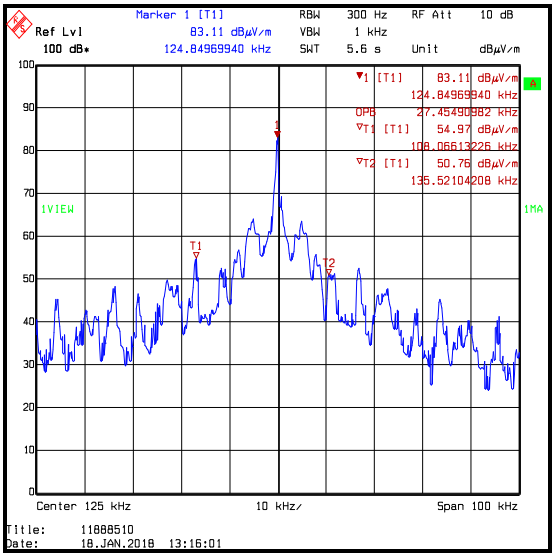
Test setup:



Transmitter 99% Emission Bandwidth (continued)

Results:

99% Emission Bandwidth (kHz)
27.5



Test Equipment Used:

Asset No.	Instrument	Manufacturer	Type No.	Serial No.	Date Calibration Due	Cal. Interval (Months)
M2009	Thermohygrometer	Testo	608-H1	45046699	20 Jun 2018	12
K0001	Semi-Anechoic Chamber	Rainford EMC	N/A	N/A	31 Jan 2018	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB	842659/016	01 Dec 2018	12
M1568	Magnetic Loop Antenna	Rohde & Schwarz	HFH2-Z2	879284/2	08 May 2018	12

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
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	±3.73 dB
Radiated Spurious Emissions	30 MHz to 1 GHz	95%	±5.65 dB
99% Occupied Bandwidth	9 kHz to 30 MHz	95%	±3.92 %

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	28	-	Corrected test equipment list
3.0	5	-	Section 2.3 updated

8. Appendix 1

GPS coordinates of test location

Mag loop location (lower marker on photo)
N51° 08.739' W001° 26.328'

30 metre test point (middle marker on photo)
N51° 08.755' W001° 26.325'

300 metre test point (upper marker on photo)
N51° 08.895' W001° 26.289'

Details of 3 metre and 30 metre open field test site used on 20 December 2017 & 21 December 2017

Temperature: 9 °C to 16 °C Relative Humidity: 71% to 84%

Ground conditions: Wet

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 power supply. The power supply was connected to a single phase supply from a portable generator. A power cable was run across the field to the EUT. 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 and support equipment were arranged according to ANSI C63.10-2013 Section 6.12.

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.

Initially, 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. The EUT and mag loop antenna were then rotated in small increments in order to maximise emission levels.

Details of 300 metre open field test site used on 20 December 2017 & 21 December 2017

Temperature: 9 °C to 16 °C Relative Humidity: 71% to 84%

Ground conditions: Wet

Measurements at 300 metres

The test site was free from underground metal objects.

The EUT was powered at its nominal voltage from its PoE power supply. The power supply was connected to a single phase supply from a portable generator. A power cable was run across the field to the EUT. 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 C63.10-2013 Section 6.12.

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.

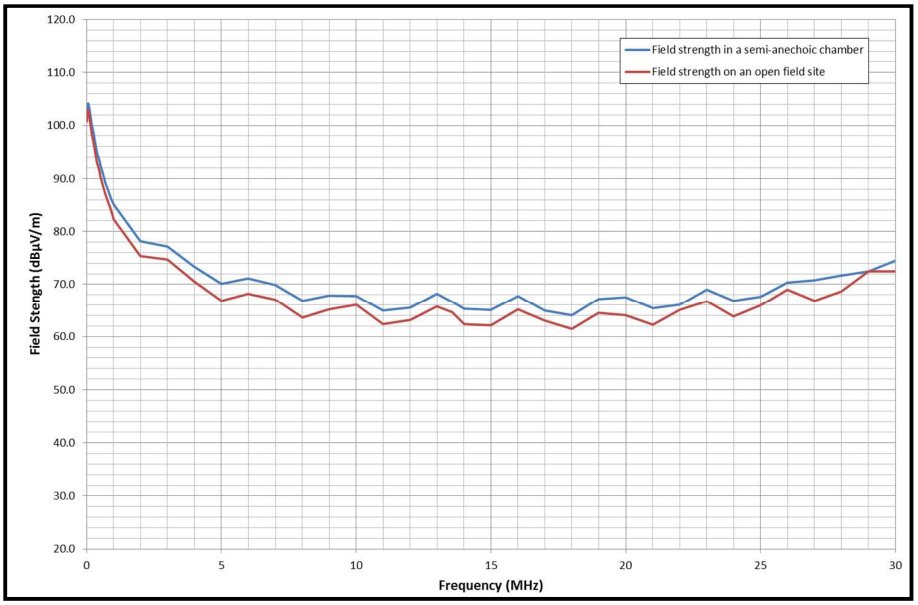
Initially, The EUT was rotated through 360 degrees in 60 degree steps at both measurement distances. The mag loop antenna was rotated through 90 degrees in 30 degree steps at every position the EUT was moved to. The EUT and mag loop antenna were then rotated in small increments in order to maximise emission levels.

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

Radiated measurements were performed an open field test site and within a 5 metre semi-anechoic chamber.

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.

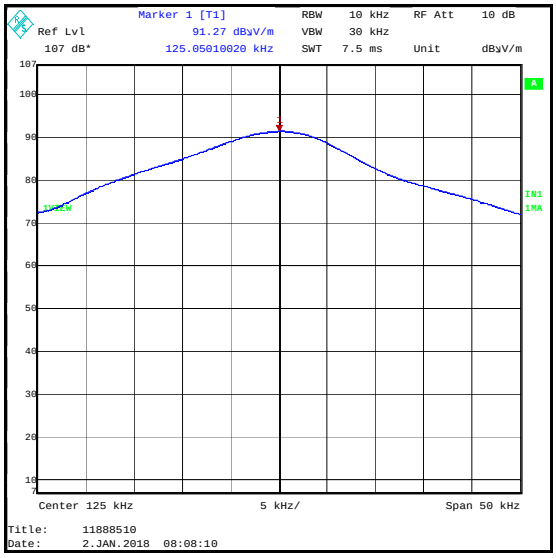
The centre of the magnetic loop antenna is placed exactly 3 metres from the reference unit. The reference unit is placed on a plastic table at a height of 0.8 metres above floor level and the centre of the mag loop antenna is 1 metre above the floor level. The mag loop antenna and reference unit are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

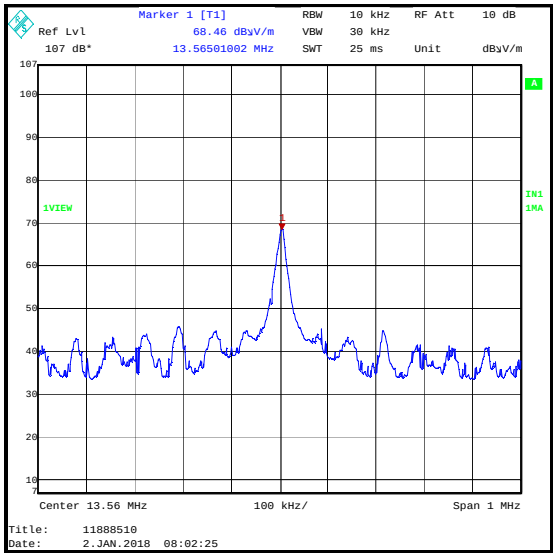
The internal verification procedure and verification plots are available for inspection on request.

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

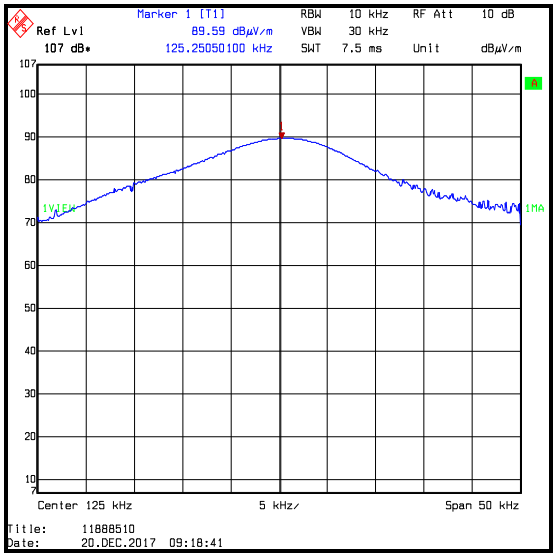
Verification plots of the two reference units at a measurement distance of 3 metres are shown on the following page. Plots were taken on an open field test site (20 December 2017) and in a semi-anechoic chamber (02 January 2018).



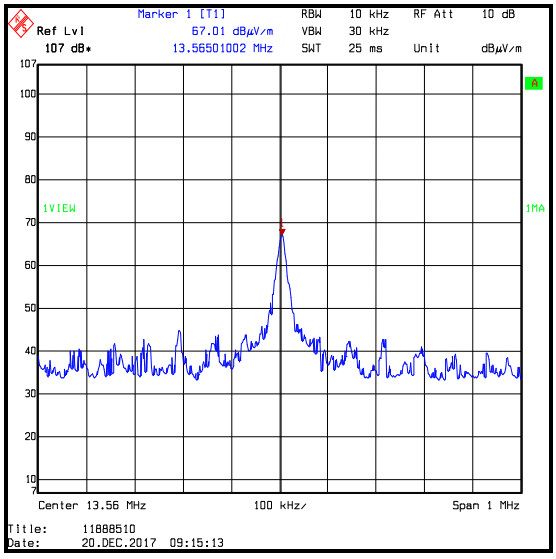
125 kHz reference unit signal at 3 metres in a semi-anechoic chamber on 02 January 2018



13.56 MHz reference unit signal at 3 metres in a semi-anechoic chamber on 02 January 2018



125 kHz reference unit signal at 3 metres on an open field test site on 20 December 2017

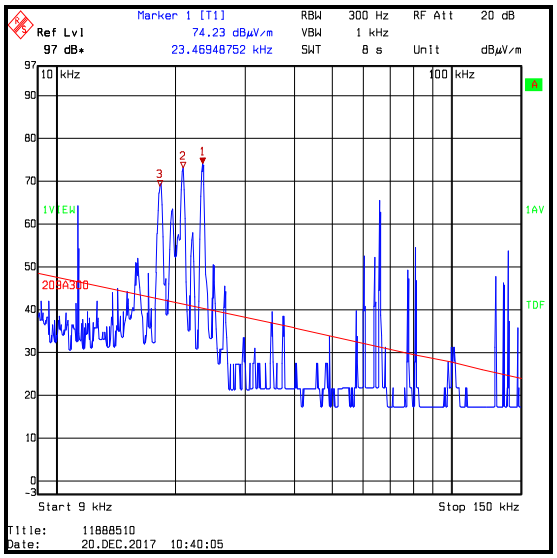


13.56 MHz reference unit signal at 3 metres on an open field test site on 20 December 2017

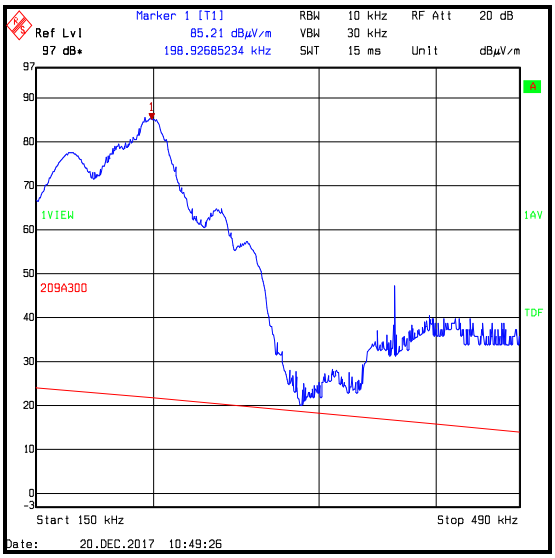
Note(s):

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.

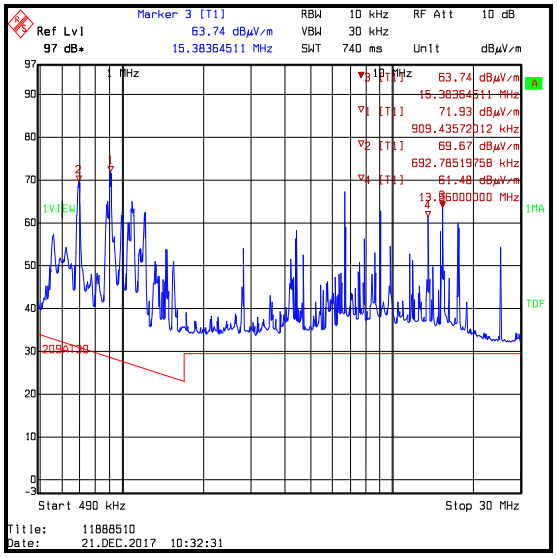
Background scans of the open field test site



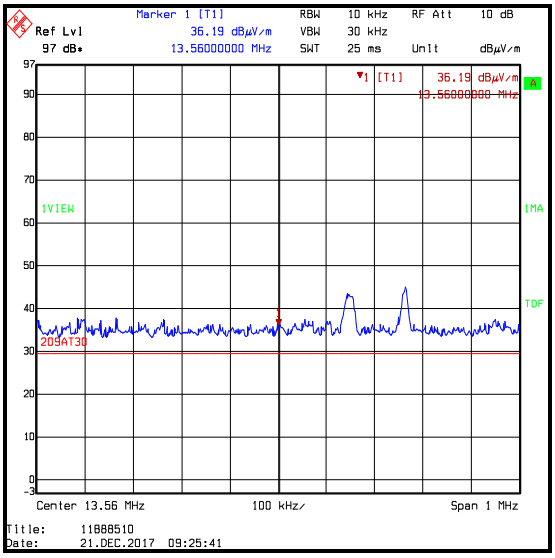
Frequency range: 9 kHz to 150 kHz
Average detector / background scan



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.

--- END OF REPORT ---