

**FCC Part 15C & Industry Canada
Certification Report**

for the

Research Instruments Ltd

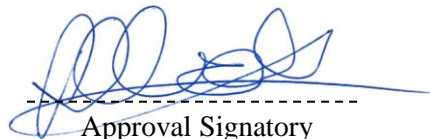
**Sperm Prep Reader,
USB and Powered via AC/DC Adapter**

FCC ID: 2ACOO-670854V5

IC ID: 12146A-670854V5



Project Engineer: R. Pennell



Approval Signatory

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The above named are authorised Eurofins Hursley signatories.

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Document History:

Issue#1: 29th August 2018 was withdrawn and replaced by Issue#2: 5th May 2020 updated with editorial correction.

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1.0 DECLARATION

1.1 FCC Part 15C and Industry Canada Statement

The Equipment Under Test (EUT) operates at a transmit frequency of 13.56 MHz and complies with CFR 47 part 15.225 emission requirements. The EUT also complies with Industry Canada RSS-210 Issue 10 and RSS-Gen Issue 5 requirements.

For emissions outside the 13.110-13.410 MHz band the EUT, as described and reported within this document, complies with the parts 15.207 and 15.209 of the CFR 47 FCC rules in accordance with ANSI C63.10:2013 and ANSI C63.4:2014.

The EUT uses passive tags without their own power source and will only work when collocated with the EUT.

1.2 Related Submittal(s) Grants

None

1.3 EUT Manufacturer

| | |
|-------------------------|---|
| Trade name: | Research Instruments Ltd |
| Company name: | Research Instruments Ltd |
| Company address: | Brickland Industrial Park Falmouth Cornwall TR11 4TA United Kingdom |
| Manufacturing address: | As above. |
| Company representative: | Mr Will Thalliens Tel: +44 (0) 1326 372753 |

2.0 EUT DESCRIPTION

2.1 Identity

| | |
|---|--|
| EUT: | Sperm Prep Reader |
| Serial numbers: | 00180 |
| Sample build: | Production |
| Powered by a Mains AC to DC Power supply: | MeanWell model GSM40A12 serial number EB82B62967 |

2.2 Product Operation

The Sperm Prep Reader (EUT) is used in fertility laboratories to track containers using RFID technology. All containers have an RFID tag attached so when they are placed in the reader tray, the reader RFID is used to digitally recognize the container identity therefore reducing human errors. The device operates at the frequency of 13.56MHz.

2.3 Support Equipment

Dell Venue 11 Pro (7130) Device ID 26C92836-E129-4461-89DF-559DC7D0FAEA

Windows 10 Pro version 1803

2.4 Exerciser Program

For the purpose of testing the following program was used to monitor the device under test.

Software: "RI WITNESS reader test tool 1.2"

The software was running on the Dell Venue tablet under Windows 10. With the software active the EUT continually transmitted, with the software application closed the transmitter turns off. The EUT was tested with 4 tags placed on EUT at the same time, 2 tags were attached to two test tubes placed in the vertical axis 3rd and 4th tags were attached to a Petri dishes in the horizontal axis.

The software is constantly sending an Inventory command which requests the ID of the tags in the work area. As the tags are passive the RF transmitter is always on, so when the tags are inside the reading area they power up and send their ID to the reader. This process is done continuously for the rear, sides and bottom antenna, one at a time. When samples are detected inside the reading area the containers are shown on the operators' display, ready to be worked on and will disappear once they are removed.

3.0 MEASUREMENT PROCEDURE AND INSTRUMENTATION

3.1 EMI Site Address & Test Date

| | |
|----------------------|--|
| EMI Company Offices | Eurofins Hursley Trafalgar House , Trafalgar Close, Chandlers Ford, Eastleigh Hampshire, SO53 4BW , UK |
| EMI Measurement Site | Eurofins Hursley Hursley Park, Winchester, SO21 2JK, UK; FCC Designation number: UK0006 ISED CAB Identifier: UK0005 |
| Test Dates | 1 st August 2018 to the 29 th August 2018 |
| HEMCS References: | 18C469 |

3.2 General Operating Conditions

Testing was performed according to the procedures in ANSI C63.10:2013, RSS-210 Issue 10, RSS Gen Issue 5 using a test site that is compliant to ANSI C63.4 2014. Final radiated testing was performed at a EUT to antenna distance of three metres (above 30 MHz).

Below 30 MHz the EUT was measured at an antenna distance of three and ten metres and compared to the limits.

Instrumentation, including receiver and spectrum analyser bandwidth, comply with the requirements of ANSI C63.2:1996.

3.3 Environmental Ambient

| Test Type | Temperature | Humidity | Atmospheric Pressure |
|-----------|------------------------------|---------------------|----------------------------|
| Radiated | 22.8 to 28.2 degrees Celsius | 35 to 55 % relative | 1013.6 to 1025.8 millibars |

3.4 Radiated Emissions

Initial Scan

Above 30 MHz a radiated profile scan was taken at a three metre distance on eight azimuths of the system under test in both vertical and horizontal polarities of the antenna in a semi-anechoic chamber. Below 30 MHz the loop antenna was set at a height of 1m, the EUT was measured with the antenna in the vertical and horizontal polarity and for each polarity a radiated emission profile obtained by revolving the system on the turntable. Instrumentation used in the chamber as below:

3.5 Test Equipment

| #ID | CP | Manufacturer | Type | Serial No | Description | Ext Calibration |
|------|----|-----------------|---------------|------------|----------------------------------|-----------------|
| 762 | 3 | Schwarzbeck | VULB9162 | 129 | 30-7000MHz | 07/04/2019 |
| 762a | 3 | Schwarzbeck | DGA 9552N | 0 | 6dB attenuator for #762 | 07/04/2019 |
| 050 | 2 | HP | 8447D | 1937A02341 | Pre-amplifier (30-1000MHz) | 06/10/2019 |
| 033 | 1 | HP | 8593EM | 3726U00203 | Spectrum analyser (9kHz-26.5GHz) | 29/11/2018 |
| 289 | 1 | Rohde & Schwarz | ESCI 7 | 100765 | CISPR 7GHz Receiver | 24/08/2018 |
| 250 | 1 | HP | 8449B | 3008A01077 | Pre-amplifier (1.0-26.5GHz) | 31/08/2018 |
| 466 | 3 | Schwarzbeck | BBHA 9120 571 | 571 | 1-10GHz Horn | 24/02/2019 |

CP = Interval period [year] prescribed for external calibrations

Note: 'Calibration due date' means that the instrument is certified with a UKAS or traceable calibration certificate.
'Internal' means internally calibrated using HEMCS procedures

The data obtained from the profile scan was used as a guide for the final Open Area Test Site (OATS) measurements.

Final Measurements

The system under test was transferred to the OATS from the semi-anechoic chamber. The data obtained from the chamber profile-scan was used to guide the test engineer. Above 30 MHz, each emission from the transmitter was maximised by revolving the system on the turntable and moving the antennae in height and azimuth. Below 30 MHz the loop antenna was set at a height of 1m, the EUT was measured with the antenna in the vertical and horizontal polarity and each emission was maximised by revolving the system on the turntable. The worst-case data is presented in this report. Test instrumentation used in the OAT's measurements was as follows:

3.6 Conducted Emissions

Test Configuration

A filtered 110V/60Hz supply was fed to the system under test, via a 50Ω/50μH Line Impedance Stabilisation Network (LISN). The LISN was directly bonded to a conductive ground plane.

Test Measurement

The worst-case emissions were identified on both the neutral and phase(s) with a spectrum analyser set to scan from 0.15 MHz to 30 MHz.

The worst-case peaks were then identified and measured using an RF receiver using a quasi-peak detector and compared to the frequency range and limits of CISPR 22 as specified by ANSI C63.4-2014. Quasi-peak values that exceeded the average limit were then re-measured using the average signal detector.

The worst-case results are presented in this report.

Test instrumentation used in the conducted test was as follows:

| #ID | CP | Manufacturer | Type | Serial No | Description | Calibration due date |
|-----|----|-----------------|----------|------------|--------------------------------|----------------------|
| 158 | 1 | Rohde & Schwarz | ESH3-Z2 | 357881052 | Pulse limiter | 07/10/2018 |
| 674 | 1 | Rohde & Schwarz | ESH3-Z5 | 838576-018 | 1 phase LISN | 03/07/2019 |
| 698 | 2 | Gauss | TDEMI30M | 1510002 | Time Domain Conducted Receiver | 24/01/2019 |

CP = Interval period [year] prescribed for external calibrations

Note: 'Calibration due date' means that the instrument is certified with a UKAS or traceable calibration certificate.

4.0 TEST DATA

4.1 Power Line Conducted Emissions

4.1.1 Data

A search was made of the frequency spectrum between 0.15 MHz to 30 MHz and the measurements reported here are the highest emissions relative to the CISPR 22 Class B limits. Emissions that meet the average limit on a quasi-peak measurement are deemed to meet both the average and quasi-peak specification.

The uncertainty of measurement for each test has been included to support a level of confidence of approximately 95%.

MAINS - NEUTRAL

| Frequency | Quasi-peak value (dB μ V) | | Average value (dB μ V) | | Status |
|-------------|----------------------------------|---------------|-------------------------------|---------------|--------|
| | Measured | Class B Limit | Measured | Class B Limit | |
| 426.769 kHz | 48.51 | 57.32 | 43.38 | 47.32 | Pass |
| 5.319 MHz | 32.38 | 60.00 | 26.63 | 50.00 | Pass |
| 13.559 MHz | 37.83 | 60.00 | 33.10 | 50.00 | Pass |
| 19.681 MHz | 30.80 | 60.00 | 25.24 | 50.00 | Pass |
| 21.799 MHz | 30.75 | 60.00 | 25.21 | 50.00 | Pass |
| 29.891 MHz | 29.62 | 60.00 | 24.25 | 50.00 | Pass |

MAINS – LINE

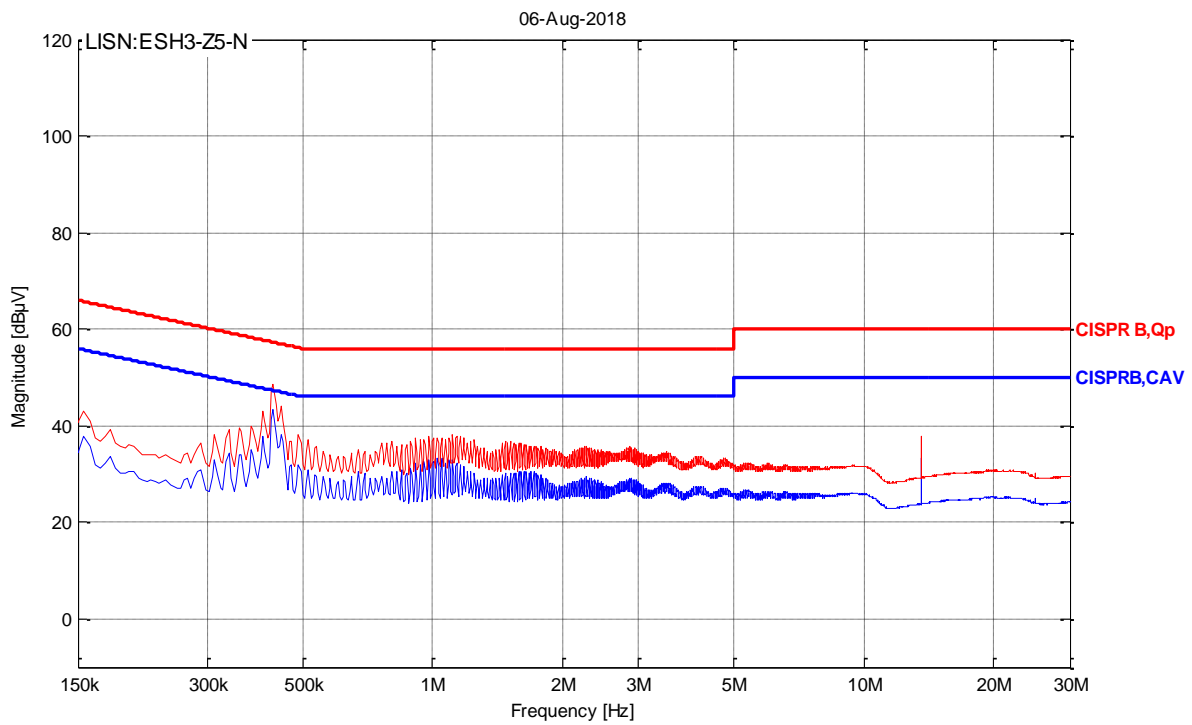
| Frequency | Quasi-peak value (dB μ V) | | Average value (dB μ V) | | Status |
|-------------|----------------------------------|---------------|-------------------------------|---------------|--------|
| | Measured | Class B Limit | Measured | Class B Limit | |
| 426.769 kHz | 48.12 | 57.32 | 42.95 | 47.32 | Pass |
| 5.343 MHz | 32.11 | 60.00 | 26.37 | 50.00 | Pass |
| 13.559 MHz | 37.39 | 60.00 | 32.69 | 50.00 | Pass |
| 19.882 MHz | 30.29 | 60.00 | 24.75 | 50.00 | Pass |
| 24.998 MHz | 30.50 | 60.00 | 24.96 | 50.00 | Pass |
| 29.953 MHz | 29.62 | 60.00 | 24.30 | 50.00 | Pass |

Uncertainty of measurement: ± 3.22 dB μ V for a 95% confidence level.

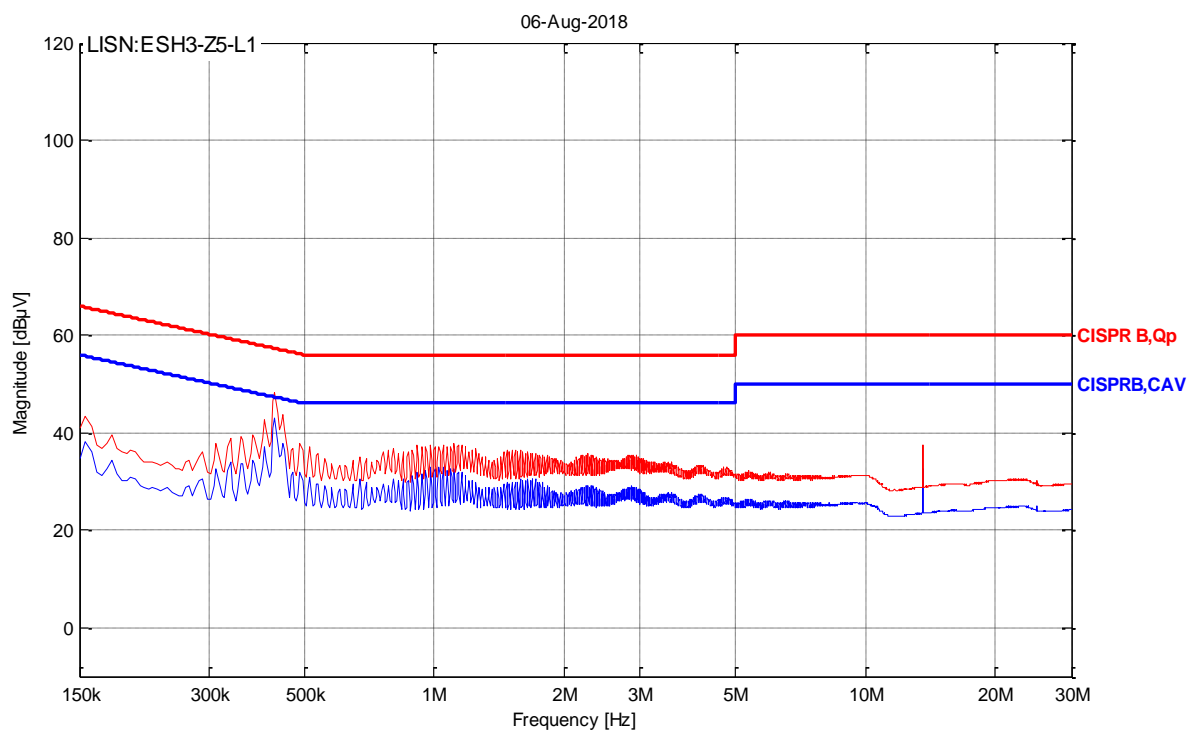
Measurements made according to the FCC rules and Eurofins Hursley test procedure CON-02.

TEST ENGINEER: Richard Pennell

Shown here is the natural plot



Shown here is the line plot



4.2 FCC – Radiated Emissions (Transmitting)

A search was made of the frequency spectrum from 9 kHz to 1 GHz and the measurements reported are the highest emissions relative to the 'FCC CFR 47 Section 15.209 and 15.225 Limits' and RSS-210 B.6 Issue 10, RSS Gen 8.9 Issue 5 limits at a measuring distance of three metres above 30MHz. Below 30 MHz the results at 3m have been compared to the limits extrapolated from 30m or 300m, the limits were extrapolated using 40 dB per decade.

Limit at 13.56MHz is calculated from FCC 15.225 as 15848uV/m at 30m => 84dBuV/m at 30m

The transmitter emission at 13.56MHz was measured at 5m and re-measured at 10m.

The extrapolation factor is calculated as follows.

E1 = 85.56 , E2 = 76.26 , D1 = 5 , D2 = 10

$$\text{Extrapolation factor } x = 20 \frac{\log\left(\frac{E_1}{E_2}\right)}{\log\left(\frac{D_1}{D_2}\right)}$$

Where: E1 field strength **uV/m** at D1 (closest distance **m**)

E2 field strength **uV/m** at D2 (farthest distance **m**)

⇒ E1 = 85.56 dBuV/m @ 5m => 18967uV/m

⇒ E2 = 76.26 dBuV/m @ 10m => 6501uV/m

$$\Rightarrow X = 20 \frac{\log\left(\frac{18967}{6501}\right)}{\log\left(\frac{5}{10}\right)}$$

⇒ X = 30.8939

D1 = 5 , D2 = 30 , E1 = 18967uV/m , E2 = ? uV/m

$$x = 20 \frac{\log\left(\frac{E_1}{E_2}\right)}{\log\left(\frac{D_1}{D_2}\right)}$$

$$\Rightarrow E2 = \frac{18967}{10^{\left(\left(\frac{-30.8939}{20}\right) \cdot \log\left(\frac{5}{30}\right)\right)}}$$

⇒ E2 = 1191.22 uV/m @ 30m => E2 = 61.52 dBuV/m @ 30m

Measurements were made using a quasi-peak detector with a 9kHz bandwidth below 30MHz and a 120kHz bandwidth above 30MHz. Below 30MHz the only significant emission was from the transmitter at 13.56MHz.

Below 30MHz no significant emissions were detected with the transmitter off (idle state).

RESULTS - 9 kHz to 30 MHz

| | Measured amplitude (E ₁) | Extrapolation | Calculated amplitude @ 30m | | Specified limit @ 30m | |
|-------|--|---------------|-------------------------------|------|--------------------------|-------|
| MHz | dBμV/m @5m | Factor (x) | dBμV/m | μV/m | dBμV/m | μV/m |
| 13.56 | 85.56 | -30.8939 | 61.52 | 1191 | 84.00 | 15848 |

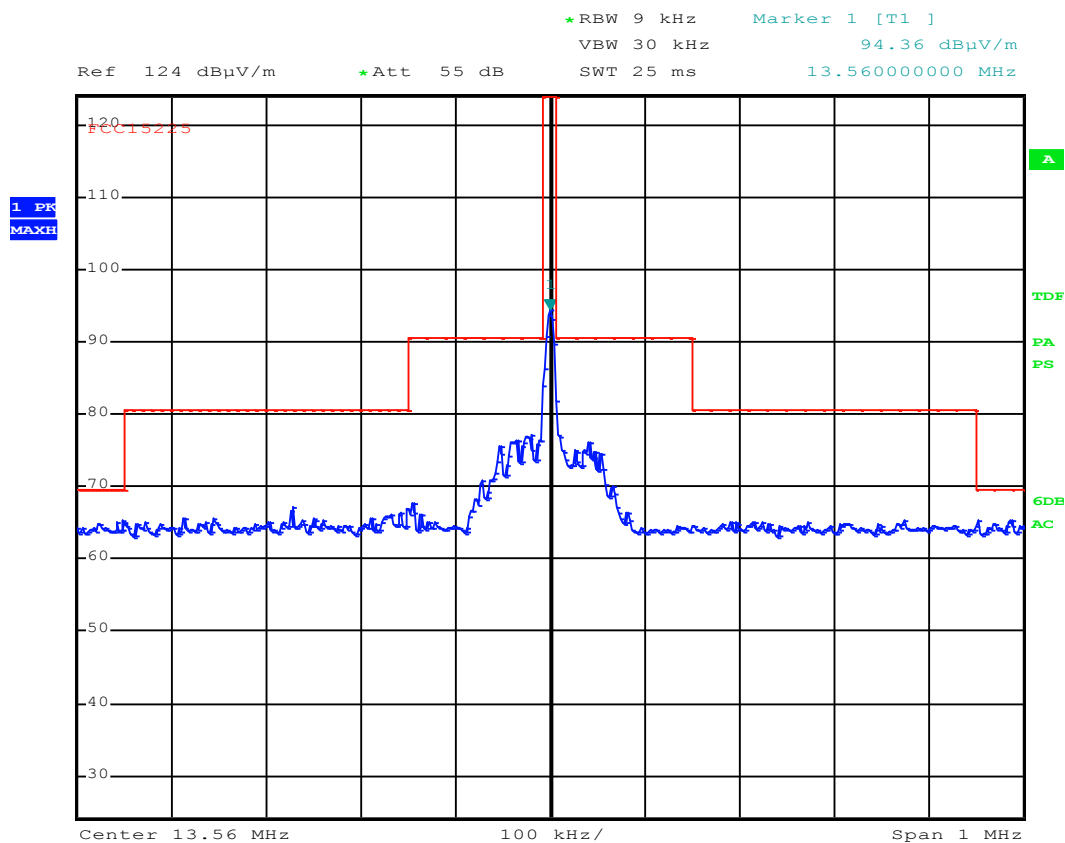
Uncertainty of measurement: ± 3.2 dBμV/m for a 95% confidence level.

4.3 Transmitter Mask

The plot below was measured at 3m with limit line corrected 40dB/decade correction in accordance with FCC 15.31(2) & RSS-210 B.6 Issue 10 to reflect the limit given at 30m.

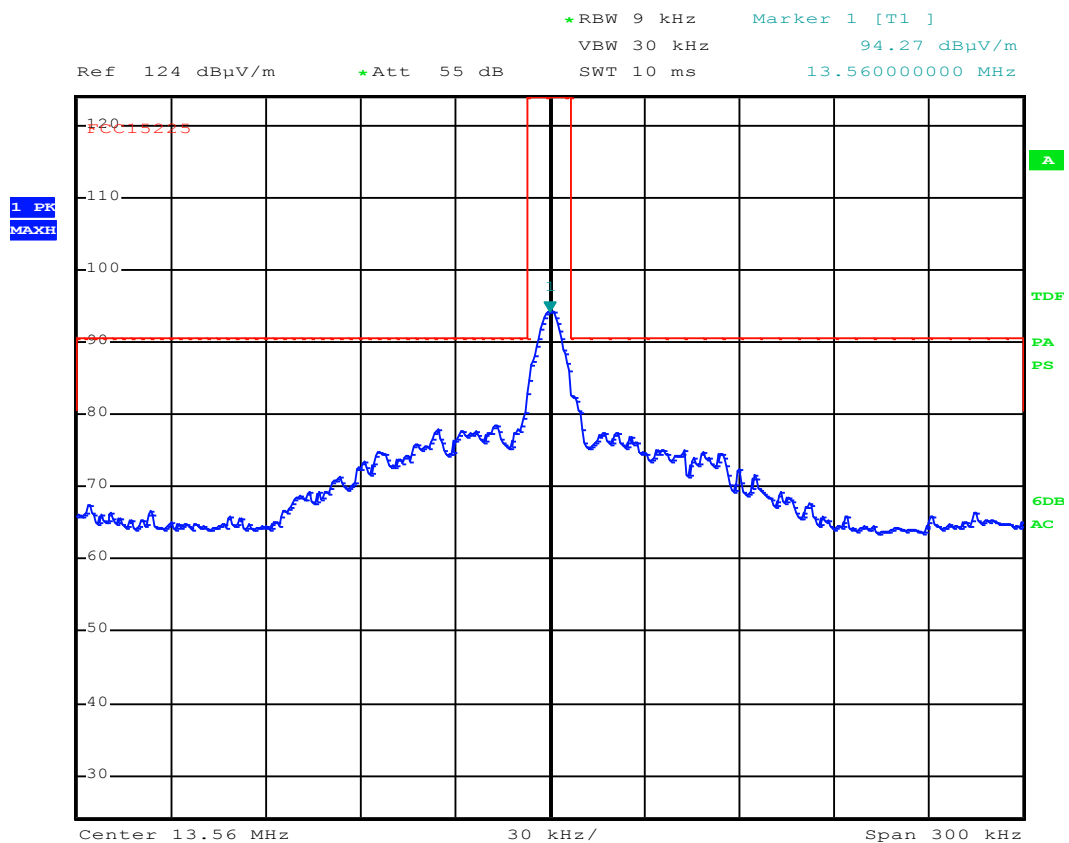
The plot shows the band edge is compliant, please note the emissions are below the noise floor.

4.3.1 Full mask plot



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4.3.2 Zoomed mask plot



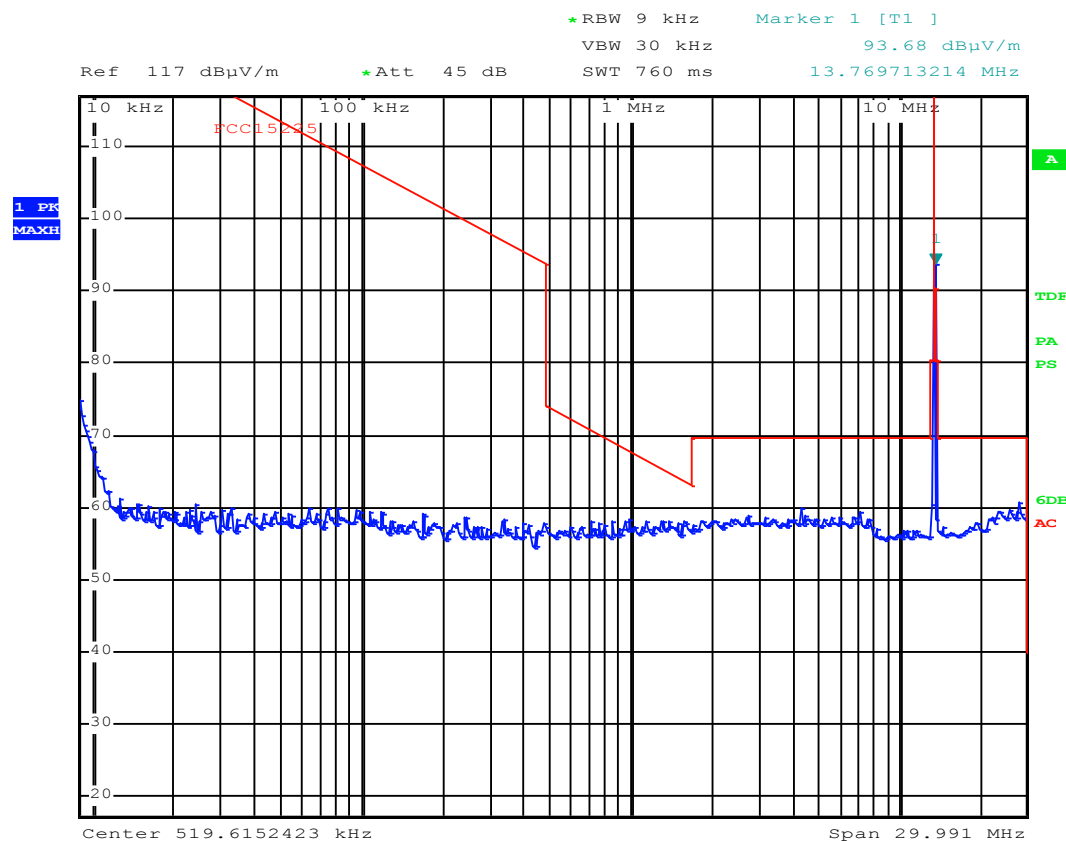
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4.4 Emissions Plots

A search was made of the frequency spectrum from 9 kHz to 1 GHz and the measurements reported are the highest emissions relative to the 'FCC CFR 47 Section 15.209 /15.255 and RSS-210 B.6 Issue 10, RSS Gen 8.9 Issue 5 Limits' at a measuring distance of three metres above 30MHz. Below 30 MHz the results measured at 3m with a corrected limit line extrapolated from 30m or 300m, the limits were extrapolated using 40dB per decade.

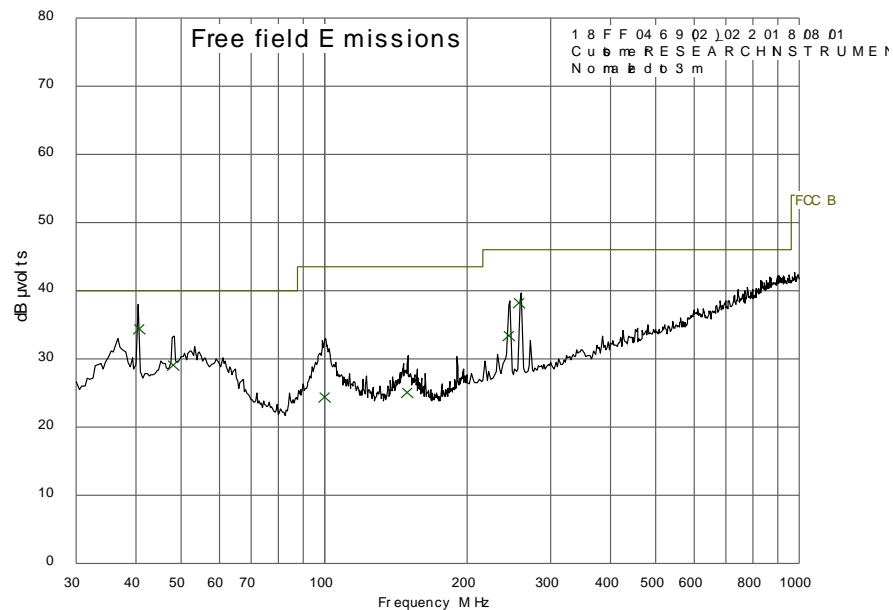
Measurements were made using a quasi-peak detector with a 9kHz bandwidth below 30MHz and a 120kHz bandwidth above 30MHz. Below 30MHz the only significant emission was from the transmitter at 13.56MHz. Below 30MHz no significant emissions were detected with the transmitter off (idle state).

Tx

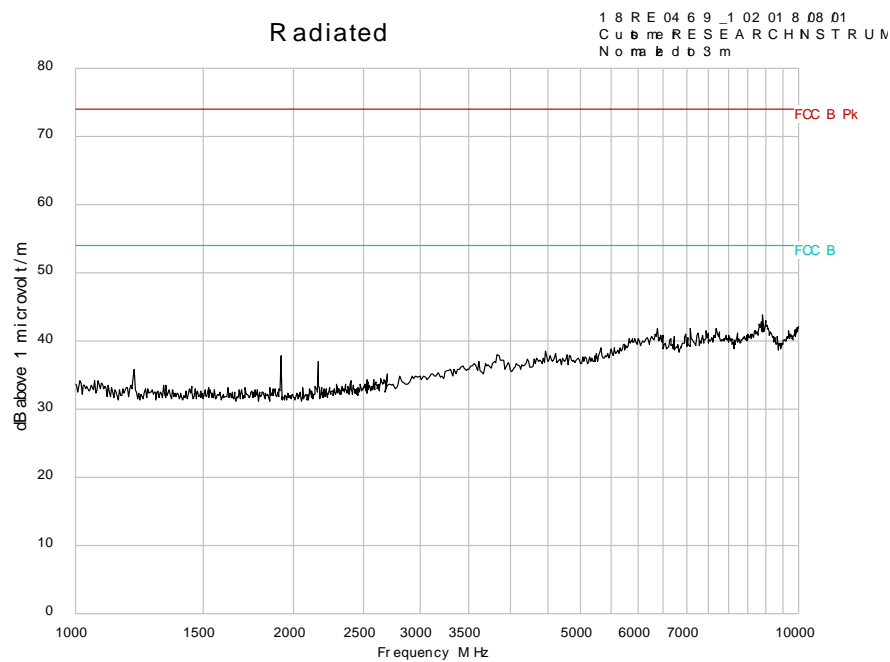


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TX



TX



Radiated emissions (continued)

RESULTS (Transmitting) - 30 MHz to 1000 MHz

| Frequency MHz | Receiver amplitude dB μ V | Antenna factor dB | Cable loss dB | Actual quasi-peak value @ 3m | Specified limit @ 3m | |
|------------------|-------------------------------------|-------------------------|---------------------|------------------------------------|-------------------------|-----------|
| | | | | dB μ V/m | dB μ V/m | μ V/m |
| 40.71 | 20.9 | 12.8 | 0.8 | 34.49 | 40 | 100 |
| 48.02 | 14.9 | 13.4 | 0.9 | 29.18 | 40 | 100 |
| 99.9 | 11.9 | 11.4 | 1.3 | 24.55 | 43.5 | 150 |
| 149.12 | 15.6 | 7.9 | 1.6 | 25.1 | 43.5 | 150 |
| 244.12 | 19.6 | 11.7 | 2.2 | 33.51 | 46 | 200 |
| 257.64 | 24.3 | 11.9 | 2.2 | 38.36 | 46 | 200 |

Uncertainty of measurement: ± 4.2 dB μ V/m for a 95% confidence level.

Procedure: In accordance with ANSI C63.4:2014

Measurements below 1.0 GHz performed with a quasi-peak detector (120kHz BW). Measurements above 1.0 GHz performed with an average and peak detector (1MHz BW).

TEST ENGINEER: Richard Pennell

4.5 Frequency Error

FCC 15.225 (e) & RSS-210 B.6 Issue 10

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C, and for a variation in the primary supply voltage from 85% to 115% (85V to 276V) of the rated supply voltage (100-240V) at a temperature of 20 degrees C.

The EUT was placed in a climatic chamber. A small loop antenna was placed in a jig under the Transmitter; the output from the loop antenna was fed via a 10 dB attenuator into the input of the ESCI 7 spectrum analyser/receiver. The frequency of the transmitter was measured with an ESCI 7 receiver.

Limit = ± 100 ppm ($\pm 0.01\%$)

| Voltage | Deg C | f (MHz) | Error (Hz) | Limit (Hz) | Pass / Fail |
|---------|---------|-----------|------------|------------|-------------|
| 100 | Ambient | 13.560037 | | - | - |
| 85 | Ambient | 13.560038 | 1 | ± 1356 | Pass |
| 276 | Ambient | 13.560034 | -3 | ± 1356 | Pass |
| 85 | -20 | 13.560192 | 155 | ± 1356 | Pass |
| 276 | -20 | 13.5602 | 163 | ± 1356 | Pass |
| 85 | -10 | 13.56018 | 143 | ± 1356 | Pass |
| 276 | -10 | 13.560179 | 142 | ± 1356 | Pass |
| 85 | 0 | 13.560179 | 142 | ± 1356 | Pass |
| 276 | 0 | 13.560182 | 145 | ± 1356 | Pass |
| 85 | 10 | 13.5601 | 63 | ± 1356 | Pass |
| 276 | 10 | 13.560096 | 59 | ± 1356 | Pass |
| 85 | 20 | 13.56001 | -27 | ± 1356 | Pass |
| 276 | 20 | 13.56001 | -27 | ± 1356 | Pass |
| 85 | 30 | 13.559994 | -43 | ± 1356 | Pass |
| 276 | 30 | 13.559998 | -39 | ± 1356 | Pass |
| 85 | 40 | 13.559926 | -111 | ± 1356 | Pass |
| 276 | 40 | 13.559933 | -104 | ± 1356 | Pass |
| 85 | 50 | 13.559912 | -125 | ± 1356 | Pass |
| 276 | 50 | 13.559911 | -126 | ± 1356 | Pass |

TEST ENGINEER: Richard Pennell

4.6 Occupied Bandwidth

Section 6.7 of RSS-GEN and ANSI 63.10 6.9.3

A small loop antenna was placed in a jig under the Transmitter; the output from the loop antenna was fed into the input of the spectrum analyser. The bandwidth of the transmitter was measured with an ESCI 7 receiver set to 99% Occupied Bandwidth with a sampling detector on max hold. The resolution bandwidth, span and video bandwidth are indicated on the occupied bandwidth plot (modulated) included with this report.

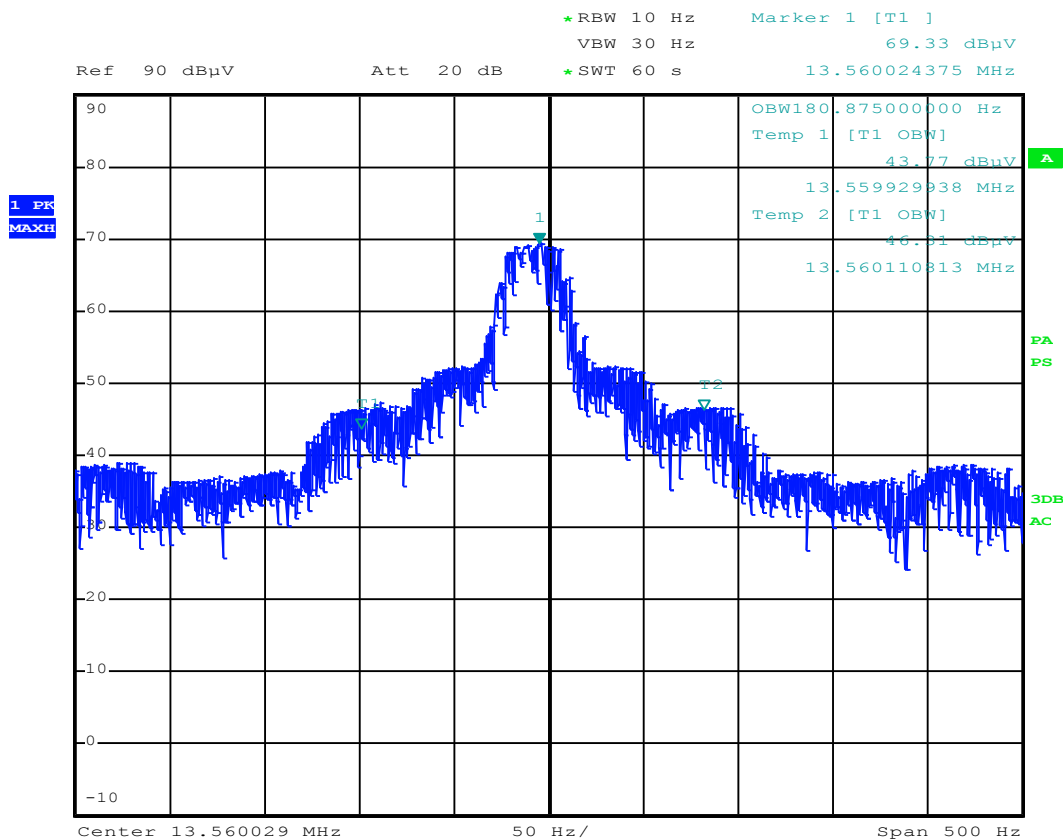
The 99% bandwidth of the Transmitter was measured as 180.875Hz (modulated).

The 20dB bandwidth of the Transmitter was measured as 110.6875Hz (modulated).

Uncertainty of measurement: 4.6% for a 95% confidence level.

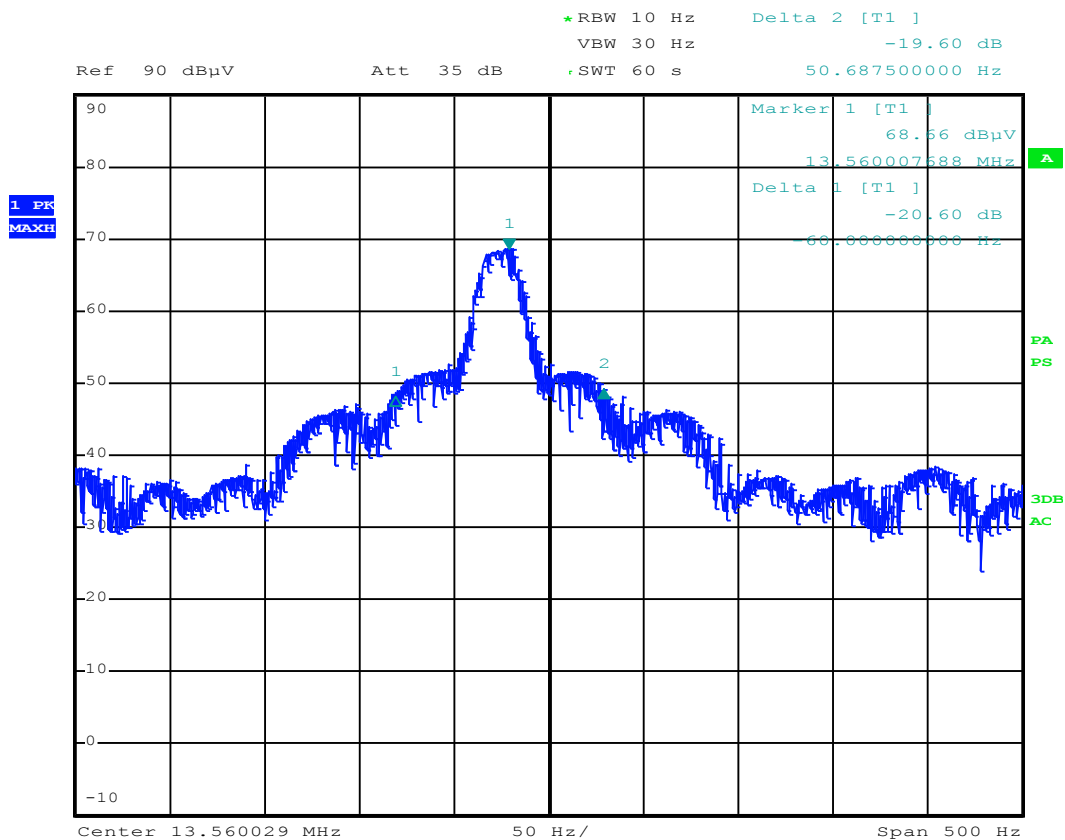
4.7 Bandwidth Plots

99% Plot



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-20dB Plot



Date: 9.AUG.2018 13:30:06

TEST ENGINEER: Richard Pennell

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