Test Report for the FCC Testing of an RDC2 Sensor Node for Digital Barriers

Test Report number 12902TR1

Project number C4113

Author: ....
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Approved: .....
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Issue	Description						Issue by	Date
1	Copy 1		Copy 2		PDF		CWG	30th August 2018

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Test Report Change History

Issue	Date	Modification Details
1	29th August 2018	Original issue of test report
2		
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Section 1Test Location

All testing was performed at;

Eurofins York	Unit 5
	Speedwell Road
	Castleford
	WF10 5PY
Tel:	01977 731173
Website	http://www.yorkemc.co.uk
UKAS Testing No.	1574

1.1 UKAS Accreditation

Tests marked "Not UKAS Accredited" in this report are not included in the UKAS Accreditation Schedule for our laboratory.

Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Eurofins York latest accreditation schedule can be found at:

http://www.ukas.org/testing/lab_detail.asp?lab_id=989&location_id=&vMenuOption=3

Eurofins York Castleford Laboratory (formerly York EMC Services), is an Accredited facility recognised by the Federal Communications Commission (FCC) for certification testing. The appropriate FCC Designation Number is number is UK0022, dated 5th September 2017

Section 2Customer Information

Company name	Digital Barriers
Address	Unit 6
	Avenue Business Park
	Brockley Road
	Elsworth
	CB23 4EY
Tel:	07824 709 153
Contact	Mr Paul Bearpark
Email	Paul.bearpark@digitalbarriers.com
Customer Representative(s) present during testing	Mr Paul Bearpark

Section 3Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	11th July 2017					
EUT name:	RDC2 Sensor Node					
Type/Part no:	039-GA-101					
Serial Number	F248 (top channel), F247 (middle channel), F245 (bottom channel)					
Hardware version	046-BOM-101 Iss 1-3					
Software version	SW00151-B-SSN-V4-1-0					
Power requirement	Battery only, 3.6V					
EUT description	The Seismic Sensor is part of an RDC unattended ground sensor (UGS) system consisting of a Master Node and a Seismic Sensor. The RDC2 Sensor Node is an Unattended Ground Sensor (UGS) which combines an innovative rapid deployment design, exceptional power efficiency and accurate target detection and classification with intelligent wireless networking.					
Operating frequency band	902-928MHz					
Number of channels tested	3 (operating band > 10MHz, 47CFR15.31|(m))					
Channels tested	902.850MHz, 915.880MHz and 926.960MHz					
RF IC	Atmel AT86RF2128					
Transmission type	Direct sequence spread spectrum.					
Modulation schemes	BPSK modulation at 40ksps					
Number of antennas tested with	One.					
Antenna type	Integral, custom designed top loaded monopole					
FCC Rule part	47 CFR 15.247					
ISED Regulation	RSS-247					
Used in close body contact (<20cm)?	No > 20cm					
Size of EUT (cm) (approx).	L: -	25cm	W:	8cm	H: -	8cm
Tested as	Floor standing					
Mode/s of operation	Transmitting continuously at the channel selected, either modulated or carrier only.					
Client modification statement:	No modifications were made.					
Modifications incorporated during testing:	No modifications were made.					

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

The apparatus was supplied in one single possible configuration. No external ports, battery powered only.

3.4 EUT Monitoring/Auxiliary Equipment

None.

3.5 Monitoring Software

None. The channel required was selected via software prior to the testing.

Section 4Test Specifications

Regulation / Test Standard	Regulation: Title 47 of the Code of Federal Regulations (CFR) Part 15 (47CFR15) Subpart C – Intentional Radiators Measurement standard: ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

Requirement	FCC Rule Part	Comments	Result Summary
6 dB Bandwidth	FCC § 15.247(a)(2)	Applies	Pass
Maximum peak conducted power	FCC § 15.247(b)(3)	Applies	Pass
Power spectral density	FCC § 15.247(e)	Applies	Pass
AC power line conducted emissions	FCC § 15.207	For mains powered apparatus only	Not applicable
Band edge compliance	FCC § 15.247(d)	Applies	Pass
Conducted spurious emissions	FCC § 15.247(d)	Applies	Pass
Transmitter radiated spurious emissions	FCC § 15.247(d) FCC § 15.209	Applies	Pass
MPE Calculation	47CFR2.1091(3)	Applies	Pass

Note 1 :All radiated emissions testing was carried out at a test distance of 3m and the limits adjusted accordingly. This is a deviation from the standard as Class A limits are specified at 10m test distance.

4.1 Knowledge Database References

The following KDBs were referenced during the testing of the RDC2 Sensor Node
The latest knowledge database references are available via the FCC KDB website at:

https://apps.**fcc**.gov/kdb

4.1.1 Radiated Emissions (30MHz to 1000MHz)

Publication Number	Keyword	Publication Date
913591	Measurement of radiated emissions at the band-edge for a Part 15 RF Device	04/05/2017

4.1.2 Radiated Emissions (1GHz to 40GHz)

Publication Number	Keyword	Publication Date
704992	Test Site Validation Requirements above 1 GHz.	12/06/2015
149045	Comparison Noise Emitter (CNE), reference noise source, .pdf	05/04/2007
913591	Measurement of radiated emissions at the band-edge for a Part 15 RF Device	04/05/2017
934285	Comparison Noise Emitters (CNE), test equipment, Broadband.pdf	05/04/2007

4.2 Compliance Statement

The Seismic Sensor, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

Section 5Spurious Emission Results – Radiated and Conducted

5.1 Test Specification

FCC Rule Part	47CFR 15.247 (d)
Standard	ANSI C63.10:2013
Measurement Uncertainty Radiated tests	The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95% is +/- 5.85dB for the frequency range 30MHz to 1GHz +/- 4.64dB for the frequency range from 1GHz to 6GHz +/- 4.96dB for the frequency range from 6GHz to 18GHz
Measurement Uncertainty Conducted tests	±1.4dB

5.2 Procedure and Test Software Version

Radiated tests:- 47CFR15.205 Restricted Bands Only

Eurofins York test procedure (30MHz to 1GHz)	CEP23b Issue 3
Eurofins York test procedure (1GHz to 40GHz)	CEP64b Issue 2
Test software	RadiMation Version 2016.2.8

Conducted Tests 47CFR 15.205 Unrestricted Bands

ANSi C63.10-2013 Clause reference:	11.11.2 and 11.11.3
Test software	Keysight Connection Expert

5.3 Radiated Emissions (30MHz to 1GHz)

Radiated electric field emission measurements are applied to the restricted bands only, defined in 47CFR15.205.

5.3.1 Limits at 3m

Frequency (MHz)	Limit (dBµV/m)
	Quasi Peak
30 - 88	40.0
88 -216	43.5
216 - 960	46.0
960- 1000	54.0

Note: FCC 47 CFR Part 15 Section 15.109 specifies test limits at 3m

Receiver Settings

Receiver Parameters	Setting
Detector Function	Quasi Peak
Start Frequency	30MHz
Stop Frequency	1000MHz
Resolution Bandwidth	120kHz
Video Bandwidth	Auto

5.3.2 Emissions measurements

5.3.3 Date of Test

11th July 2018

5.3.4 Test Area

LAB 1 (SAC)

5.3.5 Tested by

C Greenfield

5.3.6 Test Setup

The EUT was configured in the SAC on an 80cm high polystyrene table.

The measurement was performed with an antenna to EUT separation distance of 3m. The results were maximised in orientation 0-360 degrees and height 1-4m.

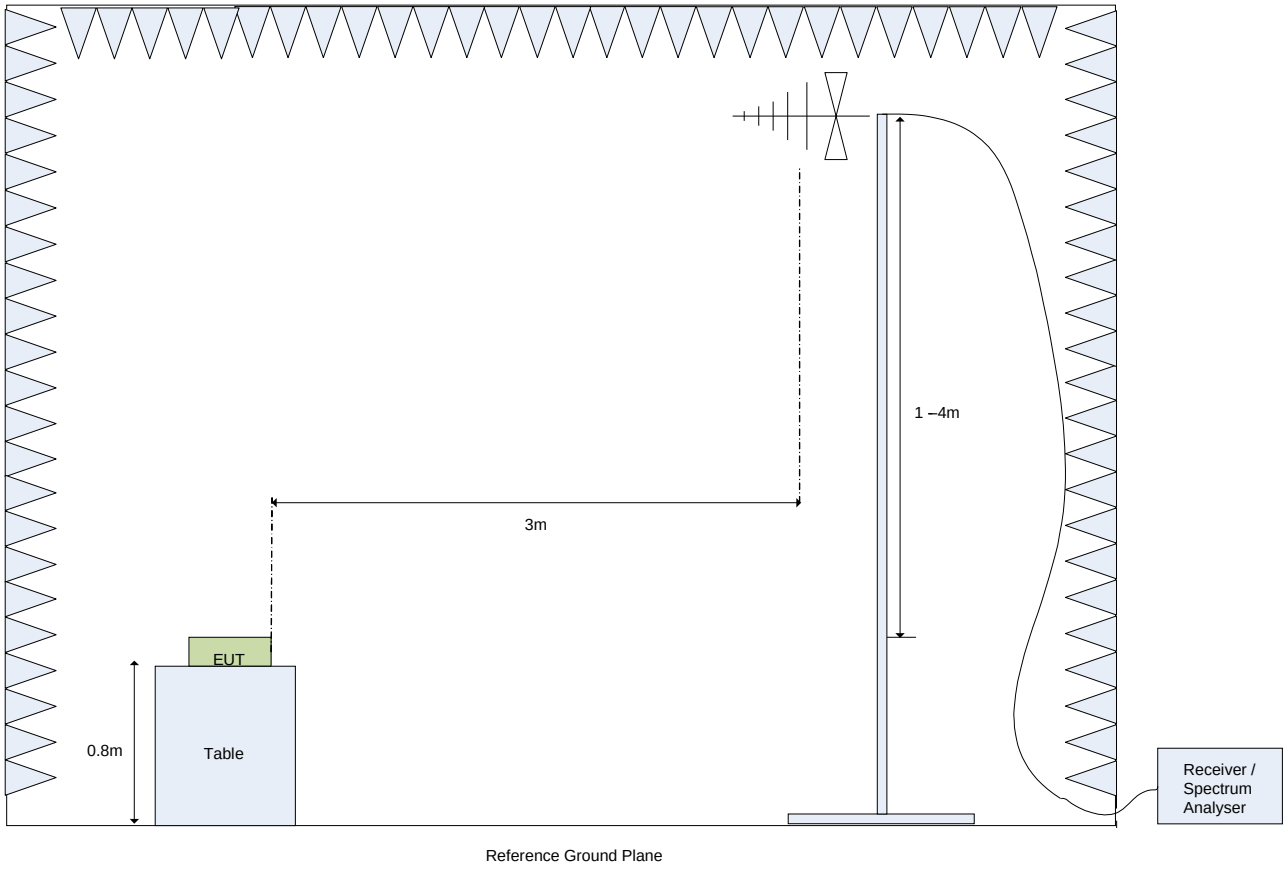


Figure 1: Test Setup for E-Field Measurements from 30MHz to 1GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.10-2013.

Note 2 : There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

5.3.7 Electric field emissions, 30MHz to 1GHz

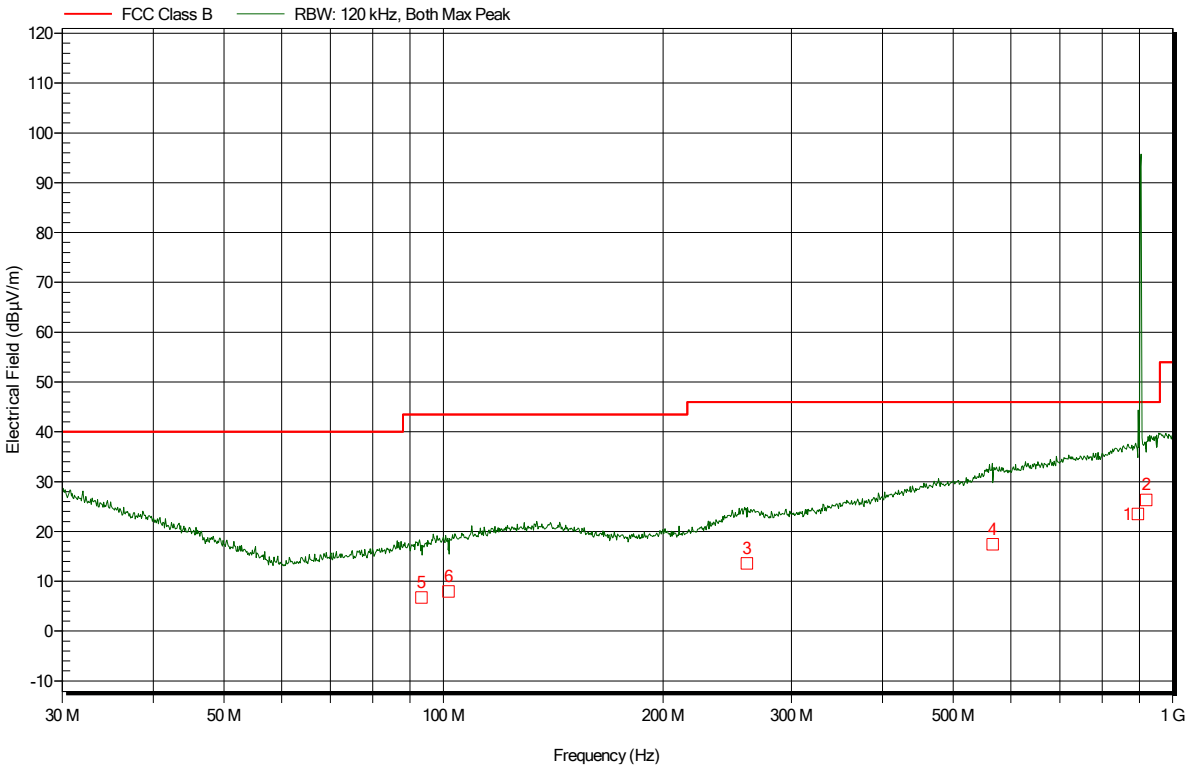


Figure 2: Electric field emissions Plot, 30MHz to 1GHz, 903MHz Operation

Frequency MHz	Quasi-Peak dBµV/m	Quasi Peak Limit dBµV/m	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Angle degrees	Height m	Polarization
93.30	6.7	43.5	-36.8	16.0	Pass	100	3.3	Horizontal
101.64	8.0	43.5	-35.5	17.0	Pass	170	3.2	Vertical
260.7	13.6	46.0	-32.4	21.8	Pass	19	2.2	Vertical
566.28	17.4	46 0	-28.6	28.5	Pass	200	1.2	Vertical
895.44	23.5	46 0	-22.5	32.8	Pass	200	1.1	Vertical
919.26	26.4	46 0	-19.6	33.8	Pass	170	1.1	Vertical

Table 1: Electric Field Emissions Peaks, 30MHz to 1GHz. 903MHz Operation

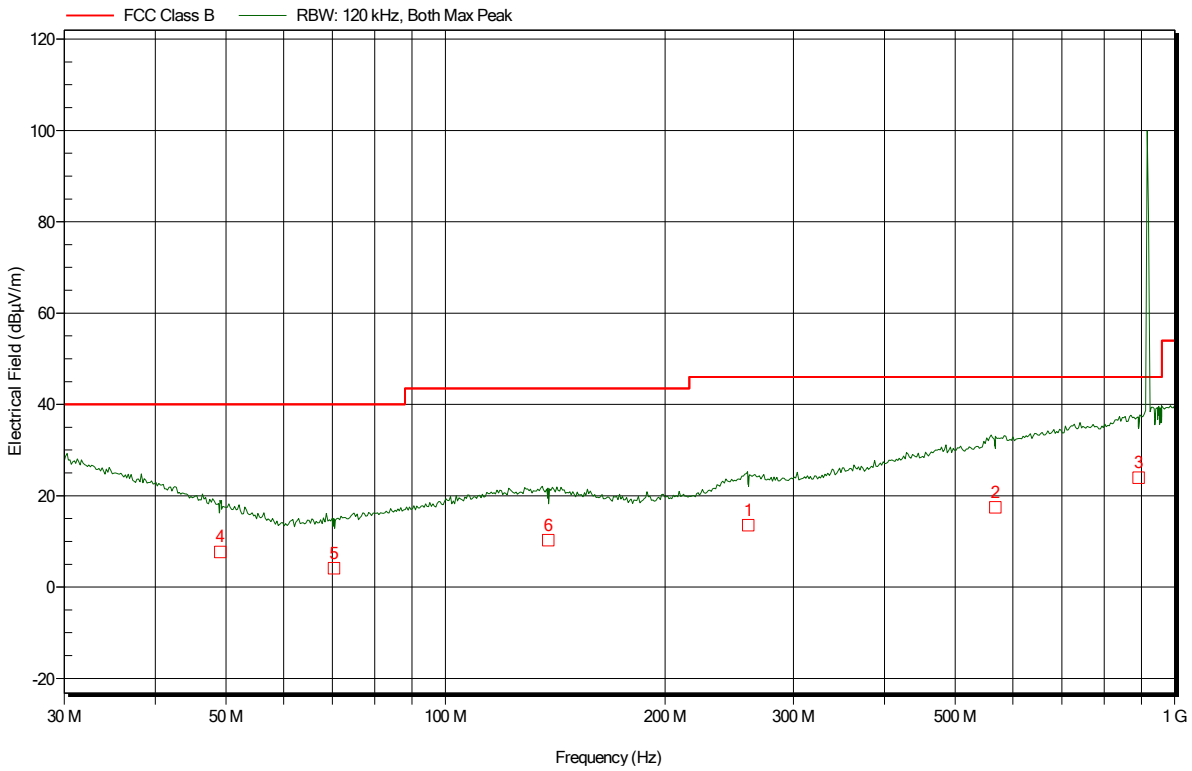


Figure 3: Electric field emissions Plot, 30MHz to 1GHz, 916MHz Operation

Frequency MHz	Quasi-Peak dBµV/m	Quasi Peak Limit dBµV/m	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Angle degrees	Height m	Polarization
49.14	7.7	40 .0	-32.3	16.8	Pass	0	2.2	Vertical
70.32	4.1	40 0	-35.9	13.4	Pass	155	1.8	Vertical
138.36	10.3	43.5	-33.2	19.2	Pass	225	1.6	Vertical
260.16	13.5	46 .0	-32.5	21.9	Pass	180 D	1.8	Vertical
567.24	17.4	46.0	-28.6	28.5	Pass	345	1	Vertical
891.84	24 .0	46 0	-22.0	32.7	Pass	350	1	Vertical

Table 2: Electric Field Emissions Peaks, 30MHz to 1GHz. 916MHz Operation

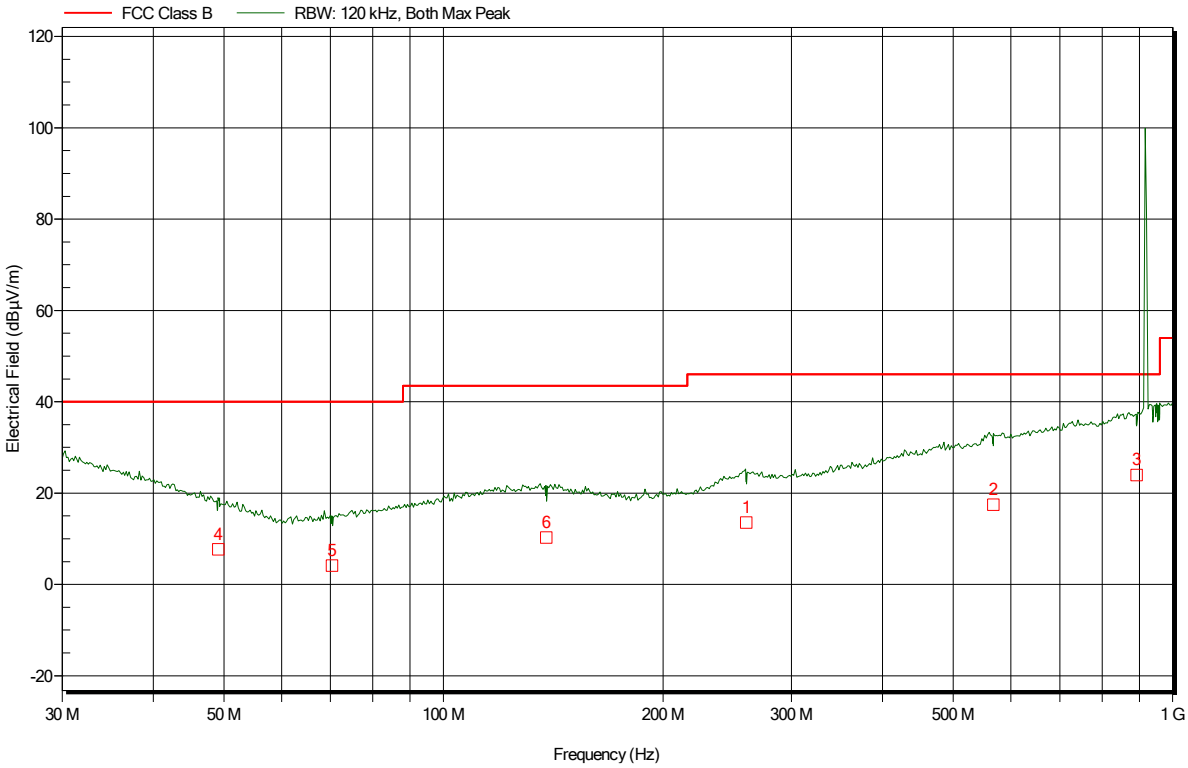


Figure 4: Electric field emissions Plot, 30MHz to 1GHz 926MHz Operation

Frequency MHz	Quasi-Peak dBµV/m	Quasi Peak Limit dBµV/m	Quasi-Peak Difference dB	Quasi-Peak Correction dB	Quasi-Peak Status	Angle degrees	Height m	Polarization
257.4	13.3	46 .0	-32.7	21.5	Pass	14	2.3	Vertical
37.26	13.3	40 .0	-26.7	22.5	Pass	335	2	Vertical
836.94	21.5	46.0	-24.5	32.3	Pass	105	1.1	Vertical
919.2z	25	46 0	-21.0	33.8	Pass	345	1	Vertical
942.96	27.1	46 0	-18.9	34.7	Pass	305	1	Vertical
971.7z	24.3	54.0	-29.7	35.0	Pass	280	1.2	Horizontal

Table 3: Electric Field Emissions Peaks, 30MHz to 1GHz. 926MHz Operation

5.3.8 Quasi Peak correction factors

The quasi peak correction is shown in the above table. This correction figure consists of Preamplifier gain (PG), Antenna factor (AF); Attenuator loss (AL) and Cable loss (CL).

Field strength (FS) is calculated as follows:

FS (dBµV/m) = Indicated Signal Level (dBµV) + AF (dB/m) + CL (dB)

5.3.9 Sample Data

From Figure 2, table 1, the Quasi-Peak level at 919.26MHz is calculated as follows:

FS (dBµV/m) = -6.9(dBµV) + 30.87(dB/m) + 2.47 (dB) = 26.4dBµV/m

5.4 Radiated Emissions (1GHz to 10GHz)

5.4.1 Limits

Frequency (GHz)	Limit (dBµV/m)	Limit (dBµV/m)
	Peak	Average
1-100	74.0	54.0

5.4.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average and Peak
Start Frequency	1GHz
Stop Frequency	40GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

5.4.3 Emissions measurements

5.4.4 Date of Test

12th July 2018

5.4.5 Test Area

LAB 1 (SAC)

5.4.6 Tested by

M Render

5.4.7 Test Setup

The EUT was configured in the SAC on an 80cm high table Exploratory measurements on the EUT were carried out to identify suspect frequencies and worst case orientations, see Section 5.4.8.

The measurement was then performed with an antenna to EUT separation distance of 3m.

The antenna was kept in the “cone of radiation” from the EUT and pointed at the area both in azimuth and elevation using the tilt mechanism on the antenna mast.

The results were maximised in orientation 0-360 degrees and height 1-4m.

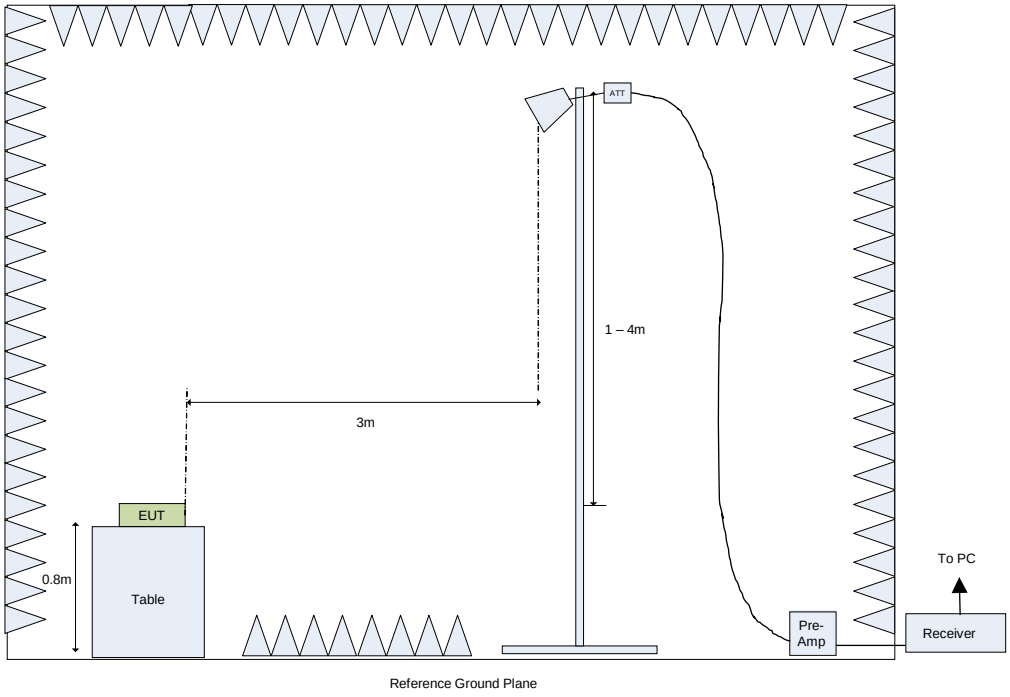


Figure 5: Test Setup for Final E-Field Measurements from 1GHz to 18GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.4-2014 Clause 5.1.3.

Note 2 : There were no significant environmental temperature changes during the test duration and hence it was not considered necessary to consider any variation in cable loss.

5.4.8 Exploratory Radiated Emission Maximization

During exploratory testing, suspect emissions from the EUT were identified both in terms of the frequency and directionality. This was achieved by manually positioning the antenna close to the EUT and also by scanning it over all sides of the EUT whilst observing a spectral display. The typical distance between the surface of the EUT and the scanning antenna was circa 30cm.

Frequency (GHz)	Mode of operation	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
1.8	902MHz transmission	Front	200	1m	Vertical
3.6	902MHz transmission	Front	200	1.5	Vertical

Table 4: Frequencies identified during Exploratory Radiated Emission maximization

Note 1 : The front face of the EUT is deemed to be 0°, which is then turned in a clockwise direction through 360°.

Note 2 : The method for the exploratory radiated emission maximisation is as detailed in Annex E of ANSI C63.4-2014.

5.4.9 Electric field emissions, 1GHz to 18GHz

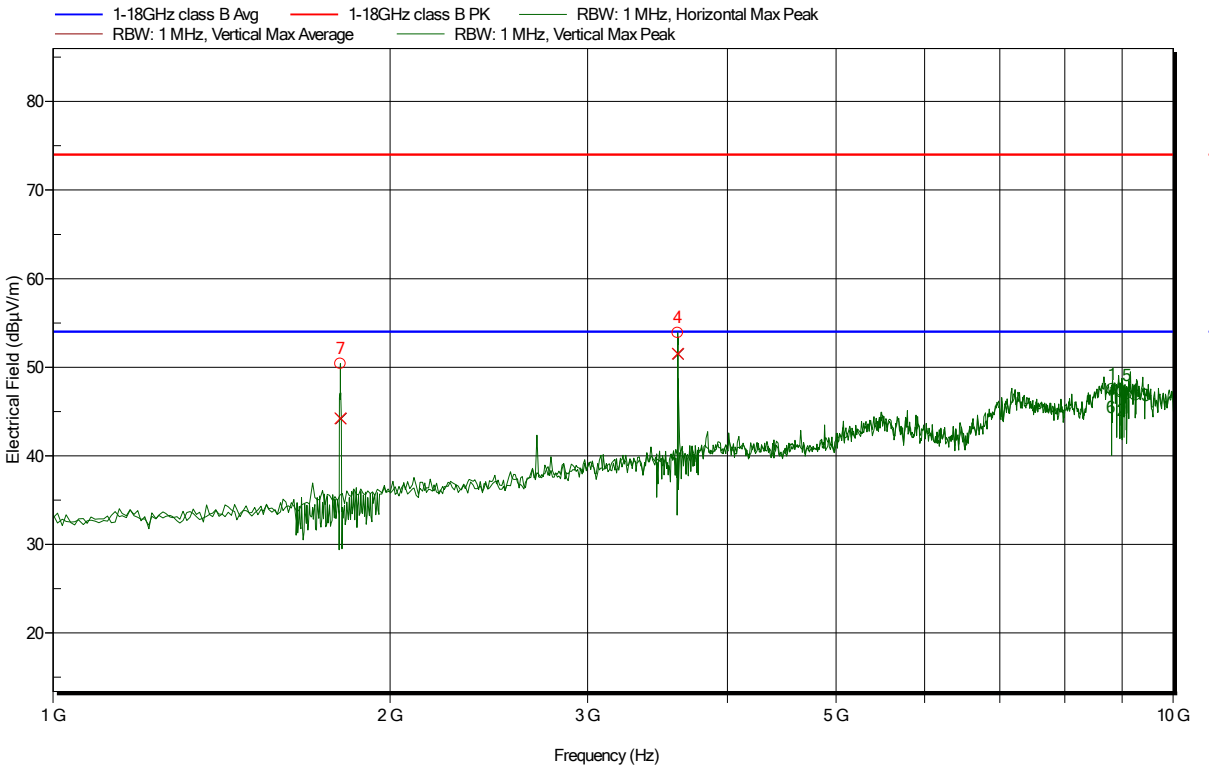


Figure 6: Electric field emissions Plot, 1GHz to 18GHz. 903 MHz Operation

Frequency GHz	Average dBµV/m	Average Limit dBµV/m	Average Difference dB	Average Correction dB	Average Status	Angle degrees	Height m	Polarization
3.612	51.53	54	-2.47	-13.4 dB	Pass	240	1 m	Vertical
1.806	44.22	54	-9.78	-19.4 dB	Pass	245	2.3 m	Vertical

Table 5: Electric Field Emissions Peaks, 1GHz to 18GHz

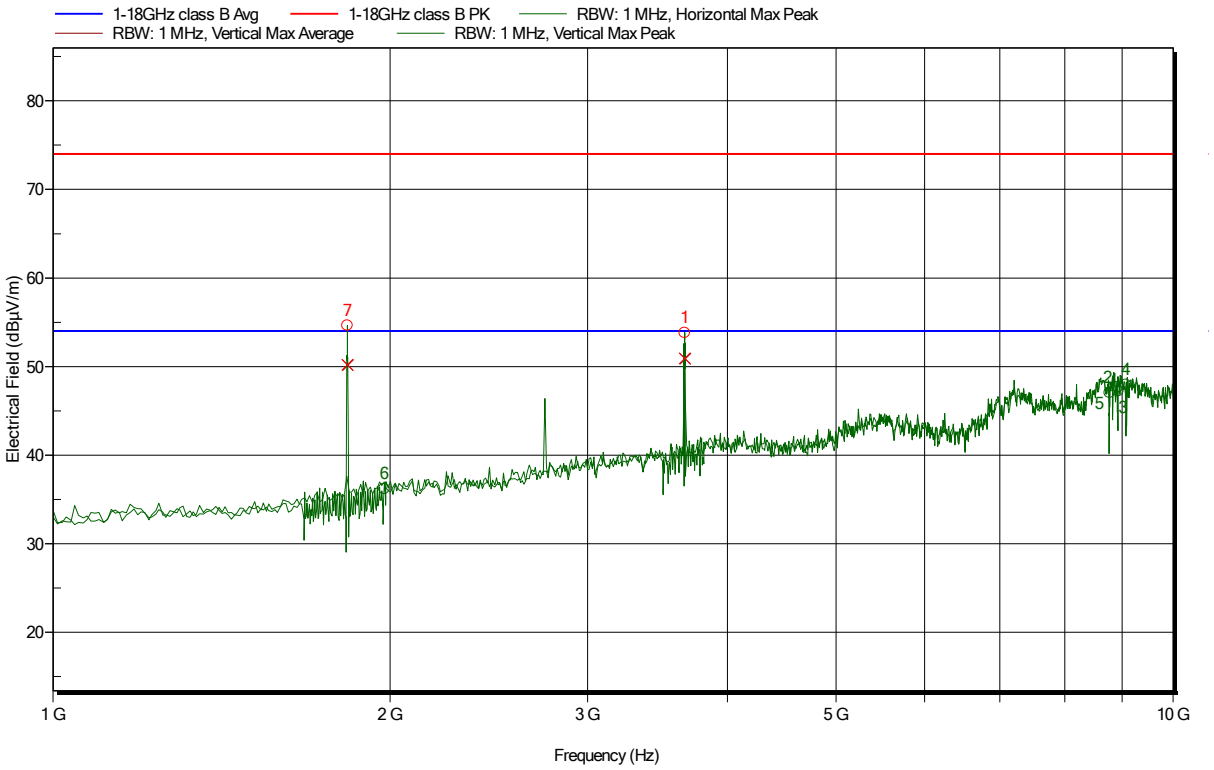


Figure 7: Electric field emissions Plot, 1GHz to 18GHz, 916 MHz

Frequency GHz	Average dBµV/m	Average Limit dBµV/m	Average Difference dB	Average Correction dB	Average Status	Angle degrees	Height m	Polarization
1.832	50.2	54	-3.8	-19.3	Pass	335	2.2	Vertical
3.664	50.91	54	-3.09	-13.2	Pass	345	1.3	Vertical

Table 6: Electric Field Emissions Peaks, 1GHz to 18GHz. 916MHz Operation

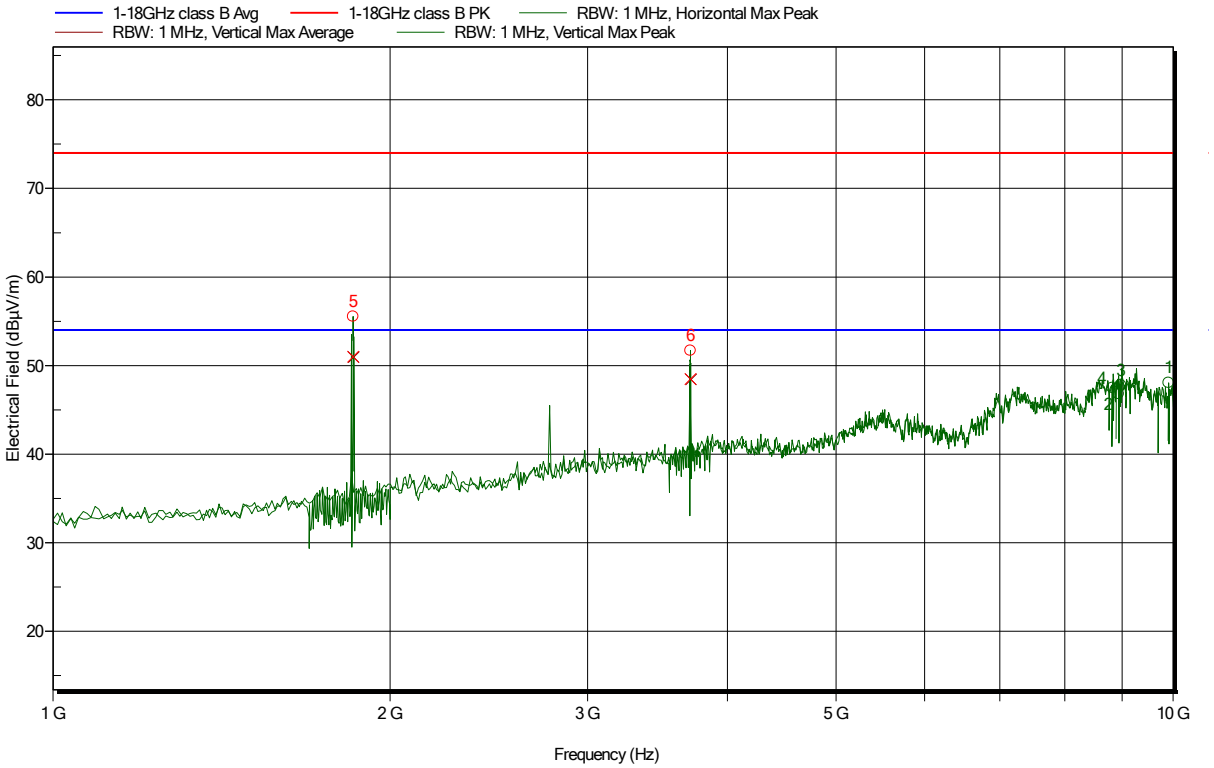


Figure 8: Electric field emissions Plot, 1GHz to 18GHz, 927 MHz

Frequency GHz	Average dBµV/m	Average Limit dBµV/m	Average Difference dB	Average Correction dB	Average Status	Angle degrees	Height m	Polarization
1.854	51.0	54.0	-3 dB	-19.1 dB	Pass	265	1.7	Vertical
3.708	48.48	54.0	-5.52 dB	-13.1 dB	Pass	290	1	Vertical

Table 7: Electric Field Emissions Peaks, 1GHz to 18GHz, 927MHz operation

5.4.10 Average correction factors

The total average corrections are shown in the above table. This correction figure consists of Preamplifier gain (PG), Antenna factor (AF); Attenuator loss (AL) and Cable loss (CL).

Field strength (FS) is calculated as follows:

FS (dBµV/m) = Indicated Signal Level (dBµV) - PG (dB) + AF (dB) + AL (dB) + CL (dB)

5.4.11 Sample Data

From Figure 5 and table 5, The Average level at 3.6121GHz is calculated as follows:

FS (dBµV/m) = = 65.1(dBµV) -50.76(dB) +31.4(dB/m) +5.74 (dB) = 51.5BµV/m

5.5 Conducted Spurious Emissions 30MHz to 10GHz

5.5.1 Limits

Frequency (MHz)	Limit, 47CFR 15.247(d) (dBµV/m)
	Peak
30 – 10GHz	20dBc

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Start Frequency	30MHz
Stop Frequency	1000MHz
Start Frequency	1000MHz
Stop Frequency	10000MHz
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Sweep rate	Auto couple
Trace mode	Max hold

5.5.2 Emissions measurements

5.5.3 Date of Test

23rd July 2018

5.5.4 Test Area

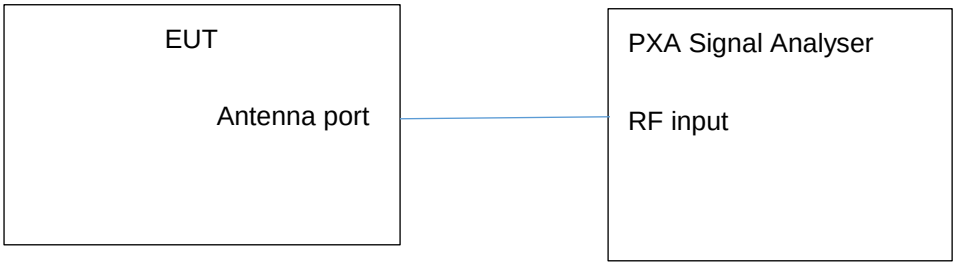
LAB 1

5.5.5 Tested by

M Render

5.5.6 Test Setup

The antenna port was connected directly to the signal analyser.



5.5.7 Test Results

The results of the conducted spurious emissions are stated below and by the signal analyser images.

All disturbances detected were > 20dB below the carrier.

5.5.8 Antenna port conducted emissions 30MHz to 10GHz

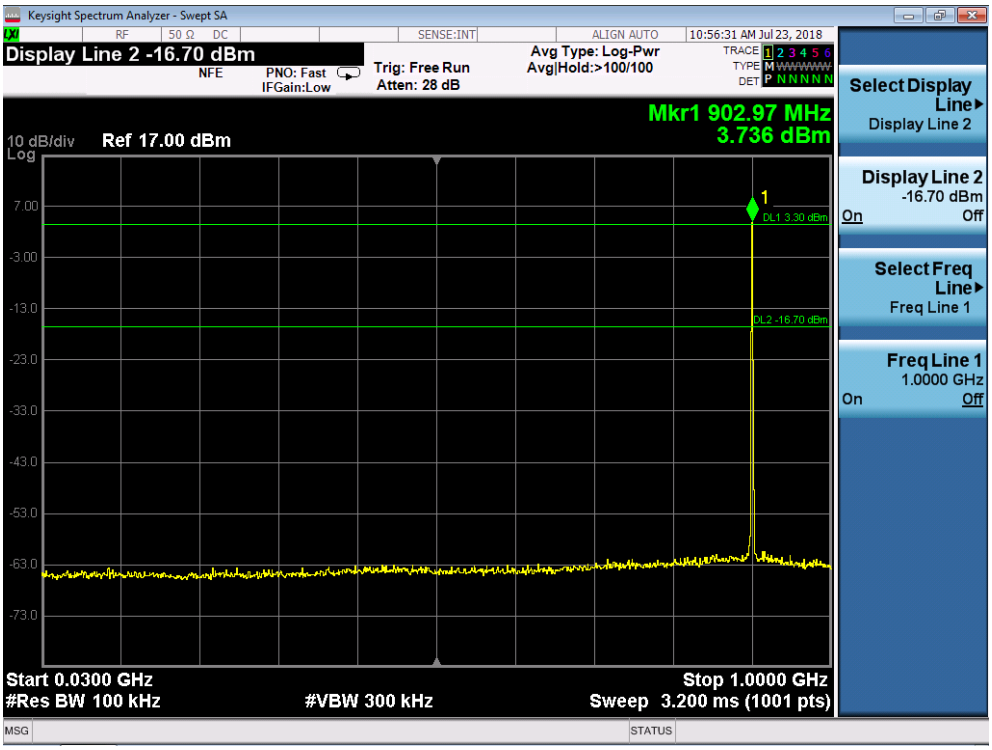


Figure 9 Conducted emissions 30MHz to 1000MHz. 903MHz Operation

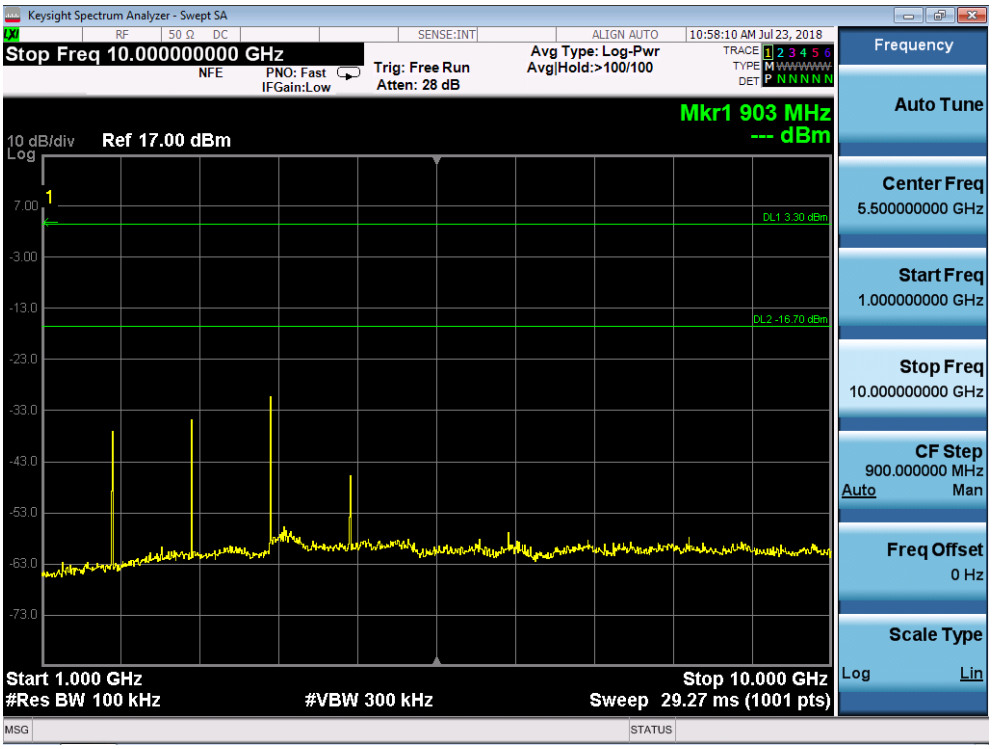


Figure 10 Conducted emissions 1000MHz to 10000MHz. 903MHz Operation

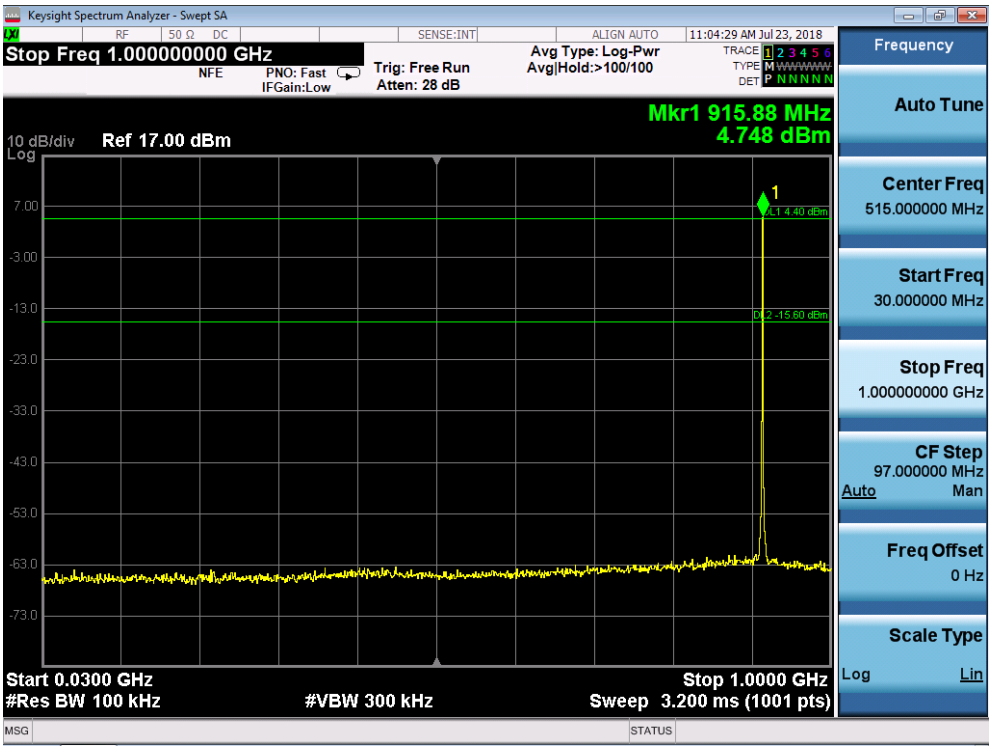


Figure 11 Conducted emissions 30MHz to 1000MHz. 916MHz Operation

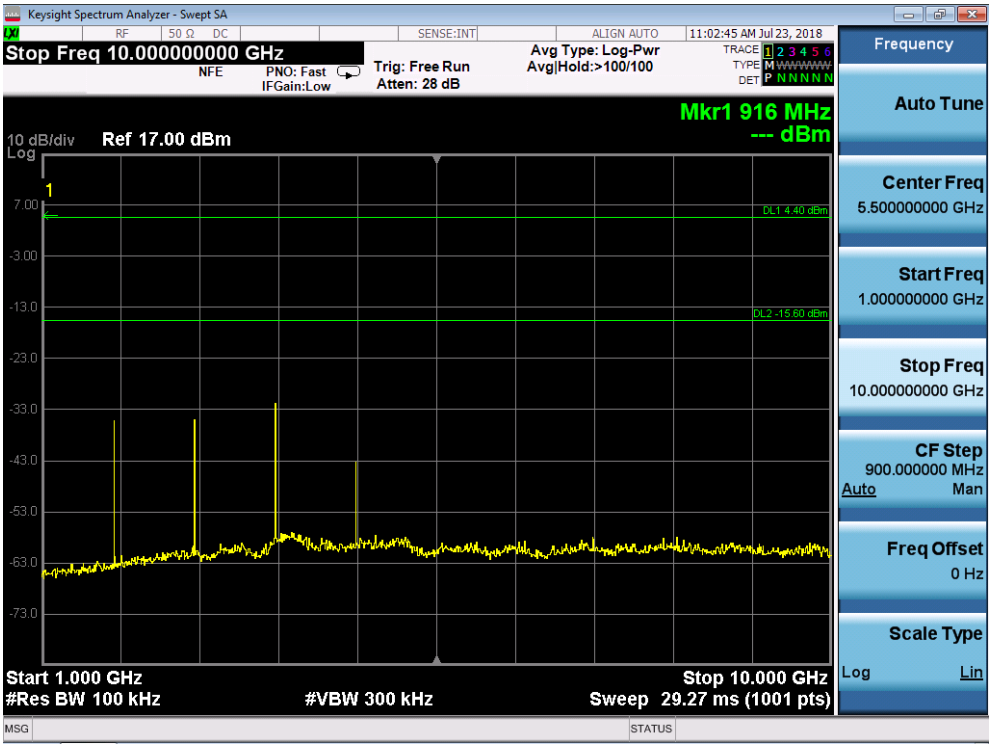


Figure 12 Conducted emissions 1000MHz to 10000MHz. 916MHz Operation

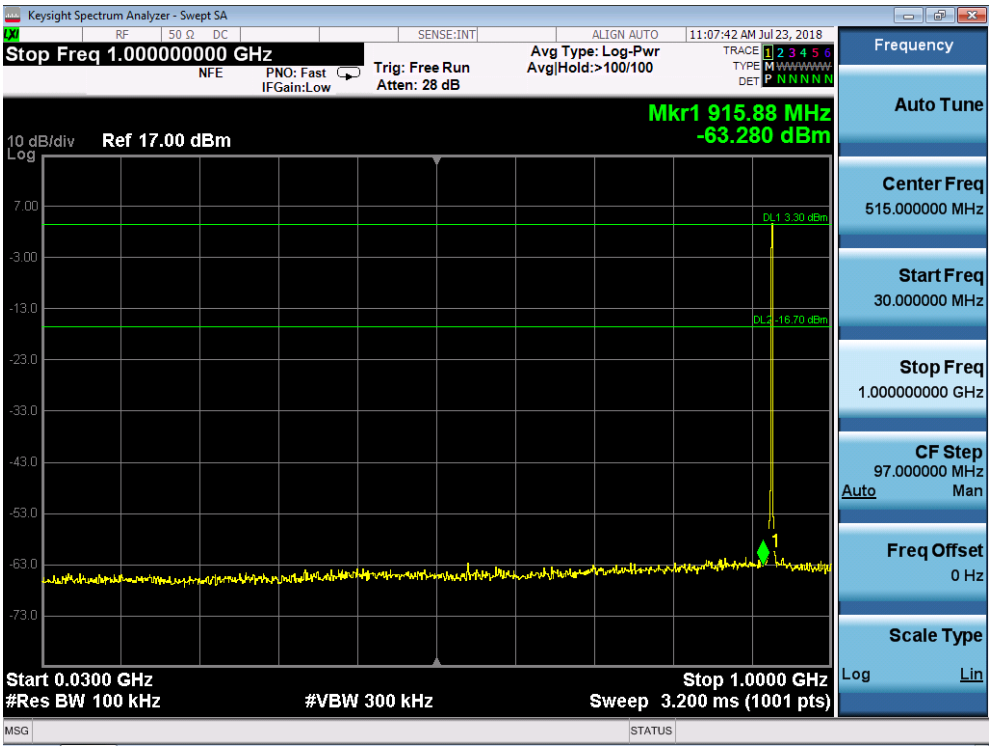


Figure 13 Conducted emissions 30MHz to 1000MHz. 926MHz Operation

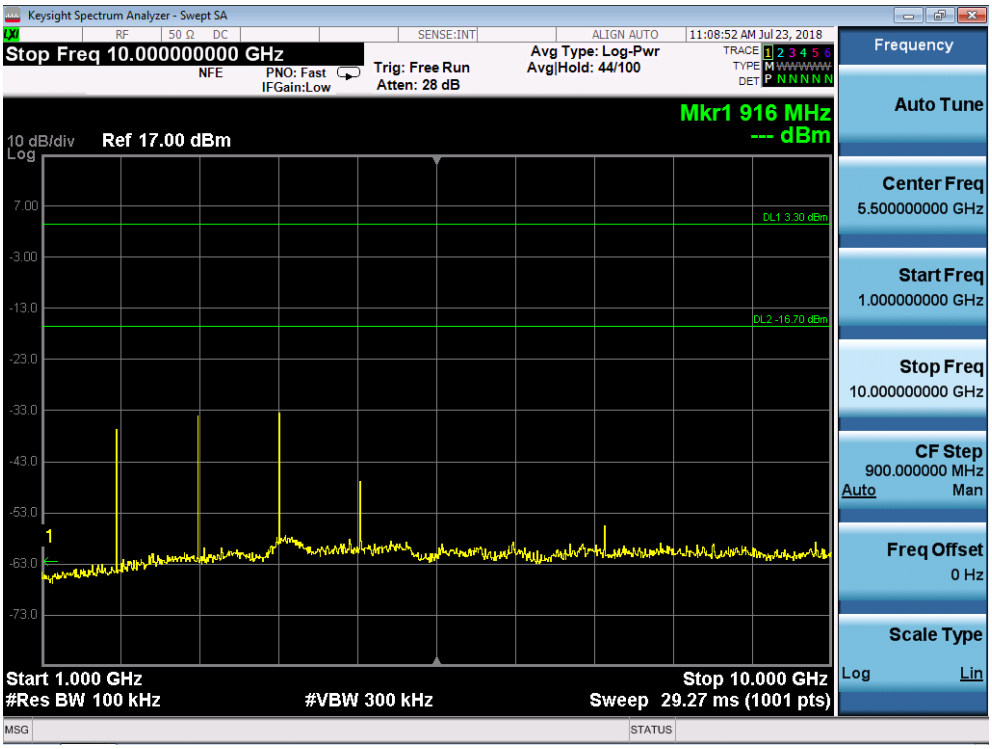


Figure 14 Conducted emissions 10000MHz to 10000MHz. 926MHz Operation

Section 6 6dB Bandwidth

6.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(2)
Standard	ANSI C63.10:2013

6.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	11.9.1.1 (RBW>DTS bandwidth)
Test software	Keysight Connection Expert

Frequency (MHz)	Limit, 47CFR 15.247(b)(2)
	Peak
902MHz to 928MHz	At least 500kHz

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Span	3 x RBW
Resolution Bandwidth	100kHz
Video Bandwidth	300kHz
Sweep rate	Auto couple
Trace mode	Max hold

6.2.1 Emissions measurements

6.2.2 Date of Test

23rd July 2018

6.2.3 Test Area

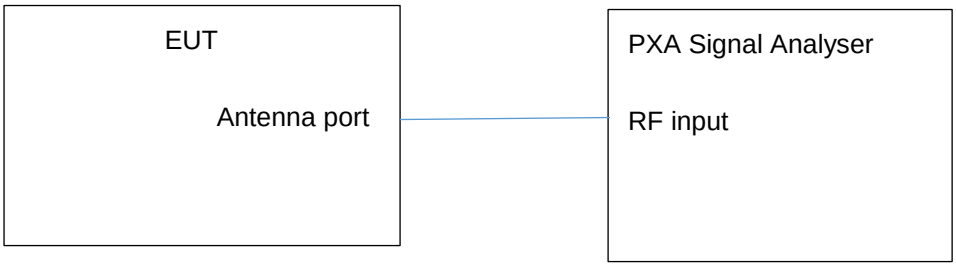
LAB 1

6.2.4 Tested by

M Render

6.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



6.2.6 Test Results

The results of the 6dB bandwidth measurements are stated in the table below and by the signal analyser images.

Channel (MHz)	Measured 6dB bandwidth (kHz)	Minimum requirement (kHz)	Figure	Result
903.00	665.3	500.00	14	Pass
916.00	666.6	500.00	15	Pass
927.00	661.4	500.00	16	Pass

Table 8 6dB Bandwidth Measurement

Figure 15 Bandwidth at 6dB Point. 903MHz Operation

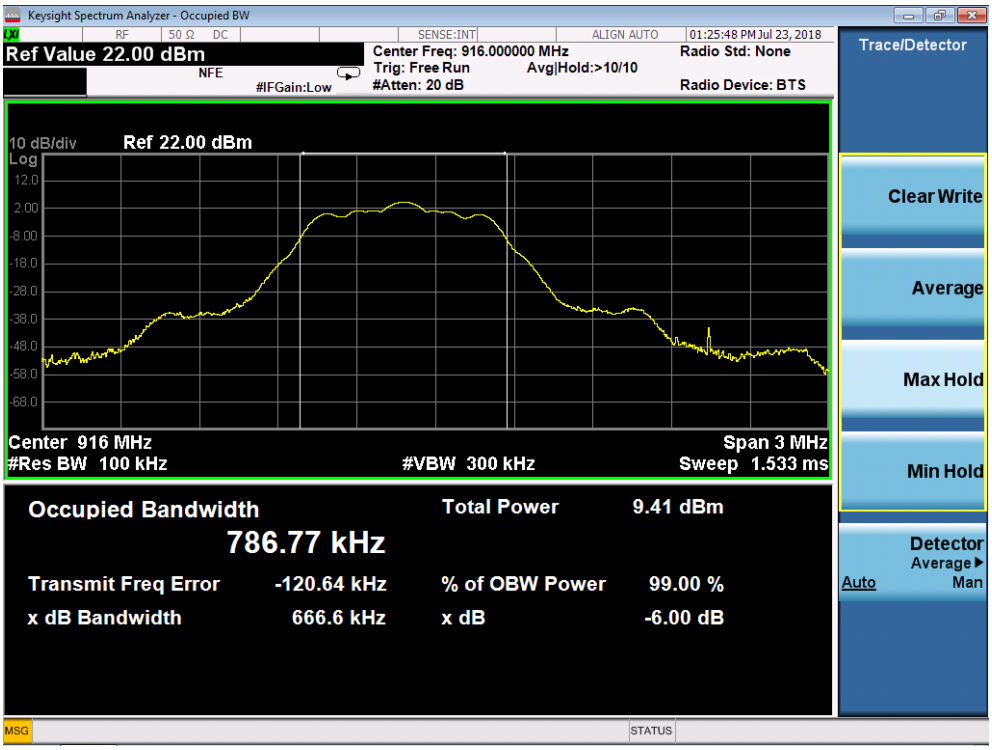


Figure 16 Bandwidth at 6dB Point. 916MHz Operation

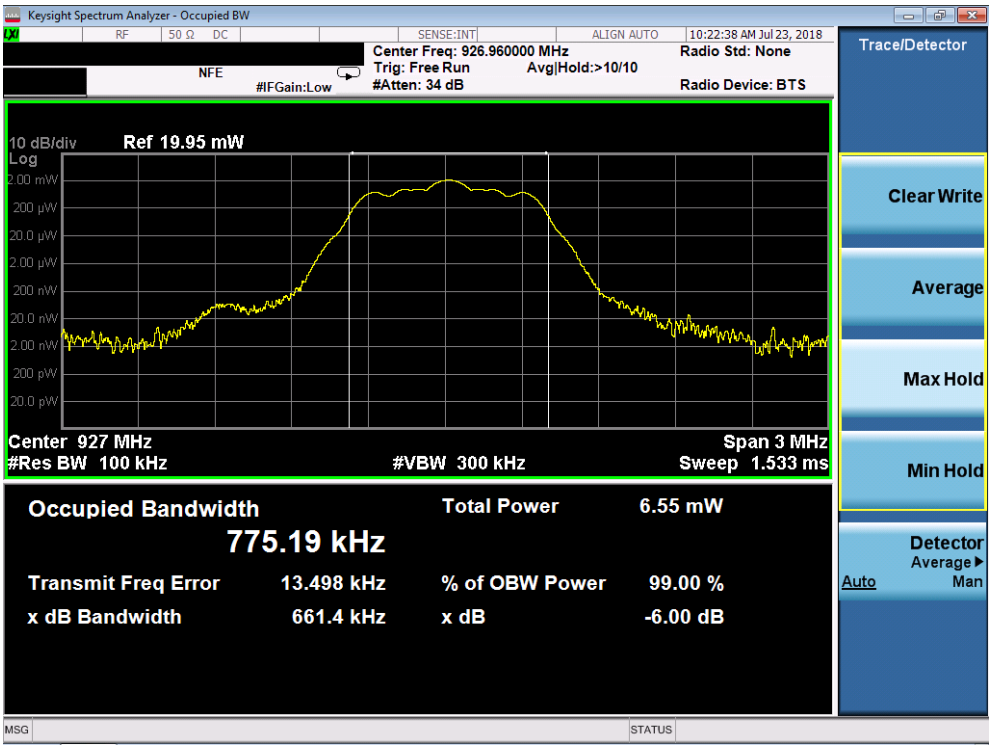


Figure 17 Bandwidth at 6dB Point. 927MHz Operation

Section 7 Peak Output Power

7.1 Test Specification

FCC Rule Part	46CFR 15.247 (b)(3)
Standard	ANSI C63.10:2013

7.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	11.9.1.1 (RBS>DTS bandwidth)
Test software	Keysight Connection Expert

Frequency (MHz)	Limit, 47CFR 15.247(b)(2)
	Peak
902MHz to 928MHz	1 watt

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Span	3 x RBW
Resolution Bandwidth	1MHz (>DTS Bandwidth)
Video Bandwidth	3MHz
Sweep rate	Auto couple
Trace mode	Max hold

7.2.1 Emissions measurements

7.2.2 Date of Test

23rd July 2018

7.2.3 Test Area

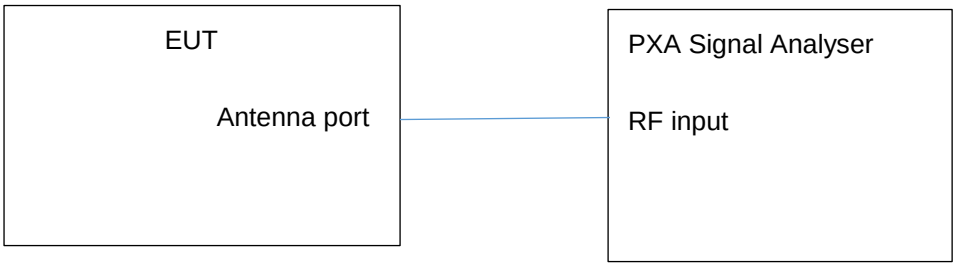
LAB 1

7.2.4 Tested by

M Render

7.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



7.2.6 Test Result

The results of the peak output power measurements are stated in the table below and by the signal analyser images.

Channel (MHz)	Measured Peak Power (watts)	Limit (watts)	Figure	Result
902.85	0.0040	1	17	Pass
916.00	0.0054	1	18	Pass
927.00	0.00416	1	19	Pass

Table 9 Peak Output Power Measurement

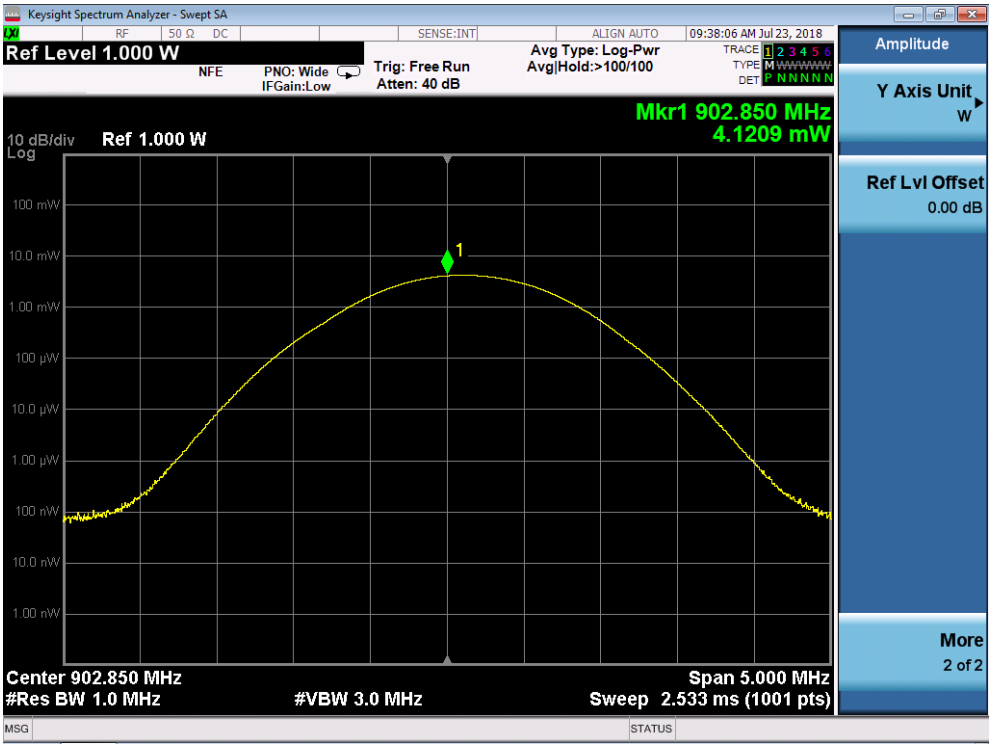


Figure 18 Peak output power, 902MHz Operation

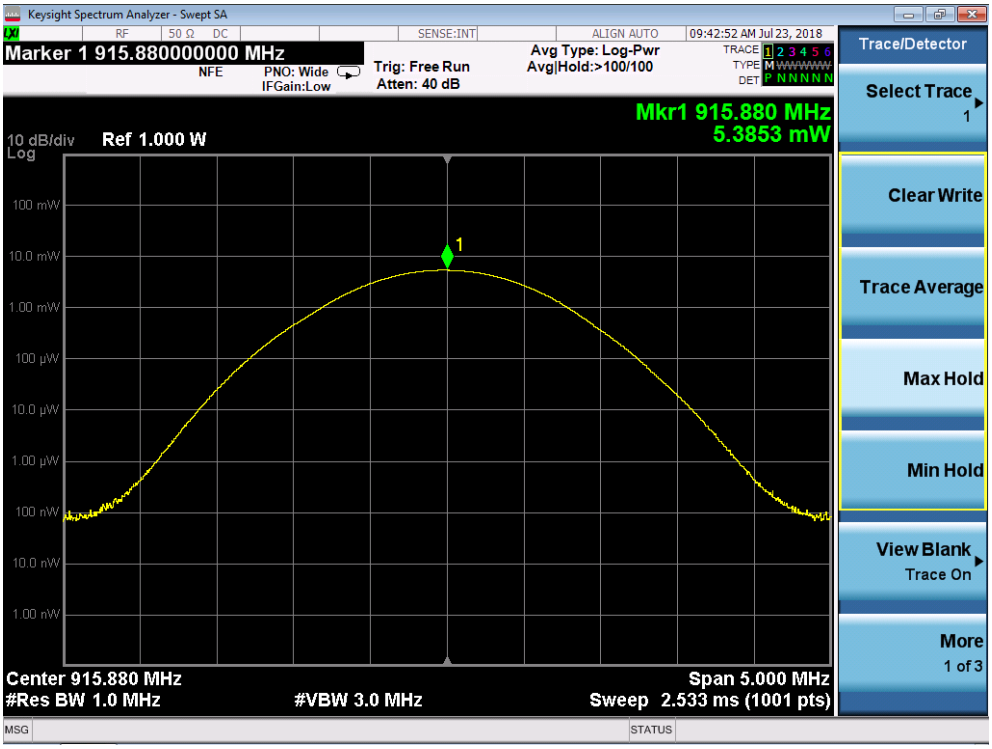


Figure 19 Peak output power, 915MHz Operation

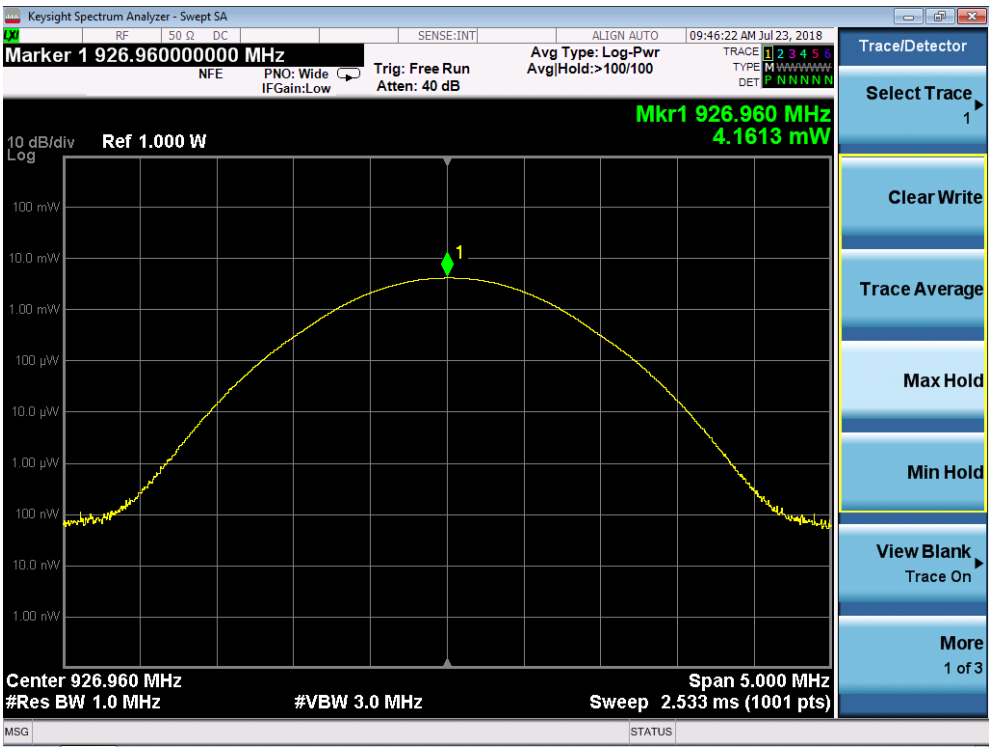


Figure 20 Peak output power, 926MHz Operation

Section 8 Power Spectral Density

8.1 Test Specification

FCC Rule Part	46CFR 15.247 (e)
Standard	ANSI C63.10:2013

8.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	Clause 11.10.2
Test software	Keysight Connection Expert

Frequency (MHz)	Limit, 47CFR 15.247(e)
	Peak
902MHz to 928MHz	<8dBm in any 3kHz band during any time interval of complete transmission

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Span	1.5xDTS bandwidth
Resolution Bandwidth	3kHz ≤RBW ≤100kHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

8.2.1 Emissions measurements

8.2.2 Date of Test

23rd July 2018

8.2.3 Test Area

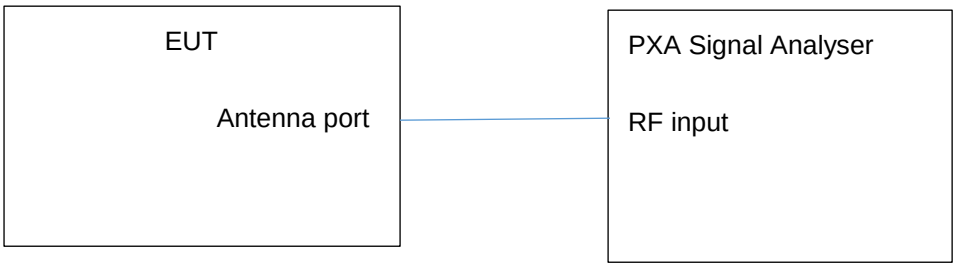
LAB 1

8.2.4 Tested by

M Render

8.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



8.2.6 Test Results

Channel (MHz)	Power in 3kHz RBW (dBm)	Limit (dBm)	Figure	Result
903.00	-5.8	8.0	21	Pass
916.00	-5.06	8.0	23	Pass
927.00	-6.2	8.0	25	Pass

Table 10 Peak Spectral Density Measurement

Channel (MHz)	Power in 100kHz RBW (dBm)	Limit (dBm)	Figure	Result
903.00	3.35	8.0	22	Pass
916.00	4.4	8.0	24	Pass
927.00	3.3	8.0	26	Pass

Table 11 Peak Spectral Density Measurement

Figure 21-Peak Spectral Density.3kHz RBW 903MHz operation.

Figure 22-Peak Spectral Density.100kHz RBW 903MHz operation.

Figure 23-Peak Spectral Density.3kHz RBW 916MHz operation.

Figure 24-Peak Spectral Density.100kHz RBW 916MHz operation.

Figure 25-Peak Spectral Density.3kHz RBW 926MHz operation.

Figure 26-Peak Spectral Density.3kHz RBW 916MHz operation.

Section 9 Band Edge Compliance

9.1 Test Specification

FCC Rule Part	46CFR 15.205
Standard	ANSI C63.10:2013

9.2 Procedure and Test Software Version

Conducted Tests

ANSi C63.10-2013 Clause reference:	Clause 6.10.4 Authorised band-edge measurements
Test software	Keysight Connection Expert

Frequency (MHz)	Limit, 47CFR 15.247(e)
	Peak
902MHz and 928MHz	No emission >20dBc at the band edge

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.11.2

Receiver Parameters	Setting
Detector Function	Peak
Span	As necessary
Resolution Bandwidth	100kHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

9.2.1 Emissions measurements

9.2.2 Date of Test

23rd July 2018

9.2.3 Test Area

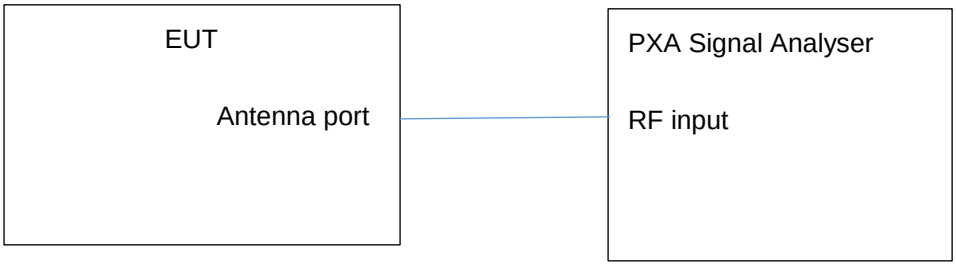
LAB 1

9.2.4 Tested by

M Render

9.2.5 Test Setup

The antenna port was connected directly to the signal analyser.



9.2.6 Test Results

Channel (MHz)	Band Edge (MHz)	dBc Measurement at Band edge	Limit (dBm)	Figure	Result
903.00	902	32.3	>20dBc	20	Pass
927.00	928	44.0	>20dBc	24	Pass

Table 10 Band Edge Measurement

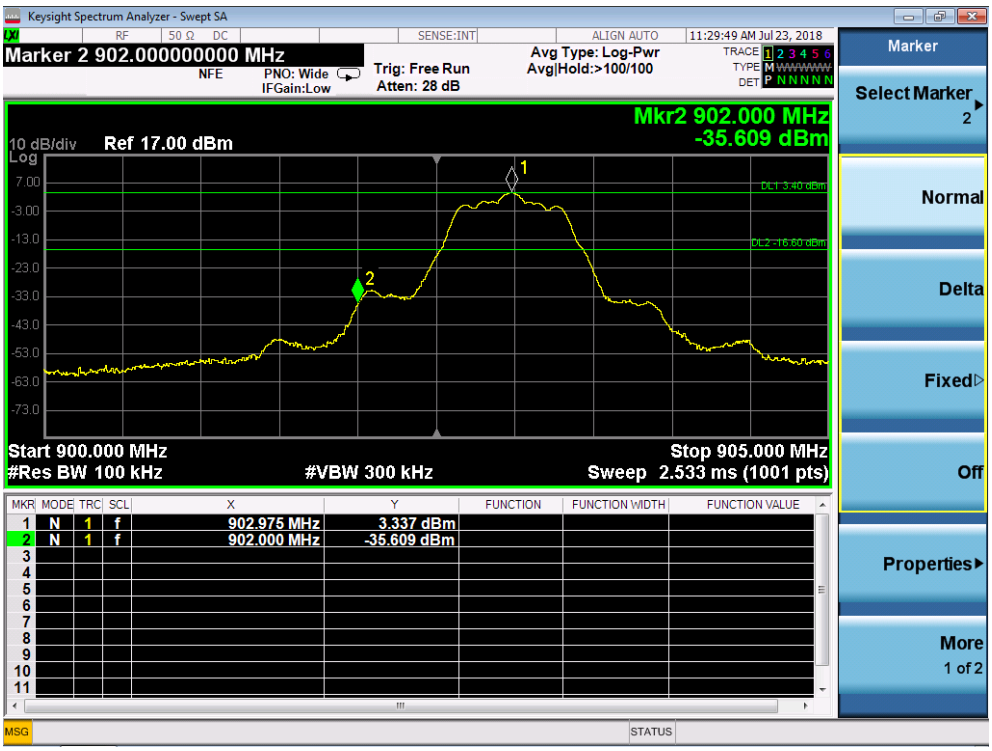


Figure 27 Authorised Band Edge Measurement – Lower Band Edge at 902MHz

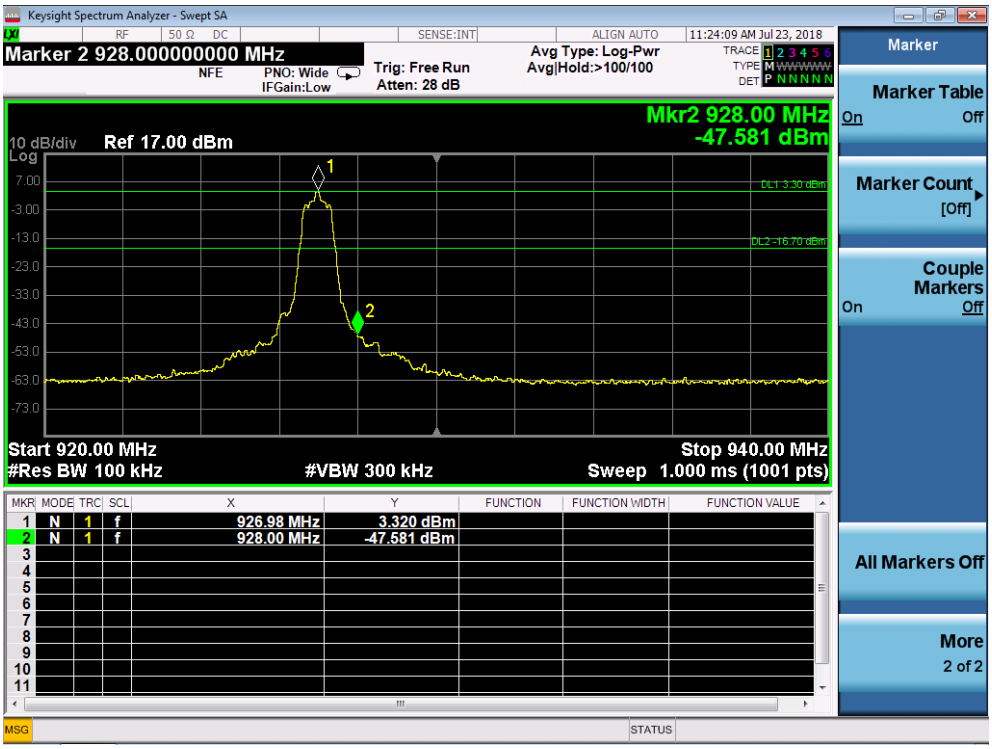


Figure 28 Authorised Band Edge Measurement – Upper Band Edge at 927MHz

Section 10 MPE Calculation

Mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and generally to be used in such a way that a separation distance of 20cm is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limit. As the 20cm separation may not be achievable under normal operating conditions, an RF exposure calculation is used to demonstrate the minimum distance required to be less than the power density limit, as required under FCC rules.

FCC rule part:47CFR2.1091(3)

Power density (S) relates to Equivalent Isotropic Radiated power (EIRP) according to the following:

$$S = \frac{EIRP}{4\pi R^2}$$

Where,

R is the distance to the centre of radiation of the antenna (cm)
*EIRP i*s in mW

Rearranging,

$$R = \sqrt{\frac{EIRP}{S4\pi}}$$

The output maximum power of the transmitter was:

The distance R is calculated as:

Frequency (MHz)	**Maximum EIRP (mW)**	**Power density limit (S) (mW/cm^2) 47CFR1.1310 Table 1***	**Distance (*R*) cm**
902.85	4.12	0.6	1.5
915.88	5.4	0.6	1.7
926.96	4.2	0.6	1.5

* Limits for General Population/Uncontrolled Exposure = 1500/ f mW/cm^2

Appendix A EUT Test Photos

Test set up photographs are supplies separately.

Appendix B Test Equipment List

Conducted Emissions from Antenna Port

Item	Serial No.	Last Calibration Date	Calibration Interval
RF Cable	Cable 9	29th January 2018	12 Months
Keysight PXA EMI Receiver	MY54170531	4th May 2018	12 Months

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	Lab 1	07/12/2016	24 Months
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	N/A	N/A
R & S ESR		14/04/18	12 Months
HF18 Cable (For use from 9kHz to 18GHz)	167004-001	14/02/2017	12 Months
Chase CBL6112B Bilog Antenna, 78167	1503	16/11/2016	24 Months
6dB Attenuator (For use with Bilog Antenna)	78708B	16/11/2016	24 Months
HF14 Cable (For use from 9kHz to 18GHz)	167003-001	11/01/2018	12 Months
HF17 Cable (For use from 9kHz to 18GHz)	167002-001	11/01/2018	12 Months
EMCO 3115 Horn Antenna 78347	9712-5380	02/05/2018	24 Months
BONN BLMA 0118-5A Preamplifier	149759	03/11/2018	12 Months