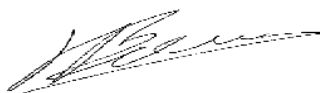


Test Report for the FCC and ISED Testing of a CowAlert IceHub for IceRobotics Ltd

Test Report number: C14230TR1
Project number: C5986


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Laboratory Business Manager

Issue	Description						Issue by	Date
1	Copy 1		Copy 2		PDF	✓	CWG	27 th August 2021

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The results contained in this report are only applicable to the apparatus tested.

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Test Report Change History

Issue	Date	Modification Details
1	13 th July 2021	First Issue
2	27 th August 2021	Second issue
3		
4		
5		
6		
7		
8		
9		
10		

Section 1 Test 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

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, is an Accredited facility recognised by the Federal Communications Commission (FCC) for certification testing.

The appropriate FCC Designation Number is number is UK02013, dated 1st March 2021.

Eurofins York Castleford Laboratory is recognised by ISED for certification testing.

ISED Assigned Code: 22959

Section 2 Customer Information

Company name	IceRobotics Ltd
Address	Bankhead Steading
	Bankhead Road
	South Queensferry
	Midlothian
	EH30 9TF
	United Kingdom
Tel:	+44 131 541 2010
Contact	Mr Gavin Saxby
Email	g.saxby@icerobotics.com

Section 3 Equipment Details

3.1 Equipment Under Test (EUT)

Date received:	12 th March 2021		
Product Marketing Name:	I-Hub		
Hardware Version Identification Number	I-Hub		
Firmware Version Identification Number	1.008		
FCC ID	WWP-I-HUB		
IC ID	8143A-IHUB		
EUT description:	Wireless Hub intended for the communication with corresponding sensors that are intended to be fitted to the rear leg of cows. The hub is a fixed station for receiving the data from the sensors		
Operating frequency band	902 – 928 MHz		
No of units tested:	One		
EUT power:	Mains Powered (110V 60Hz)		
Highest internal frequency:	928 MHz		
RF module	CC1310 MCU		
RF module manufacturer	Texas Instruments		
RF module description	CC1310 MCU is a ultra-low power Sub 1 GHz RF device		
Transmission system	DTS		
Modulation scheme(s)	WB-DSSS		
Bandwidth	622 kHz		
Number of Channels	38		
Size of EUT (mm)	Width: 190 mm	Depth: 105 mm	Height: 240 mm
Mode/s of operation	Continuous transmit of packetised data at top, middle and bottom channels.		
Modifications incorporated during testing:	None		

3.2 EUT Photographs

Photographs are supplied separately.

3.3 Configuration of EUT

The apparatus was supplied with two possible antenna configurations. Both of which have been tested within this report. The smallest of the antenna options is a 47mm ANT-868-CW-RAH Linx Quarter-wave antenna and the alternative longer antenna is a WMO86916 High Gain Omni Antenna for wall mounting.

The test set up for radiated tests is consistent with EUT use. It was supported vertically as shown in the test set-up photographs.

Support equipment consisted of the trigger Box and Power supply. For radiated emissions testing they were positioned 10cm from the EUT consistent with ANSI C63.10.

The plastic front of the enclosure contained no conductive/reflective material and for operational convenience was omitted for some tests.

3.4 EUT Monitoring/Auxiliary Equipment

None.

3.5 Monitoring Software

None. The channel required was selected and pre-set prior to the testing.

Section 4 Test Specifications

For USA:

Regulation / Test Standard	Regulation: Title 47 of the Code of Federal Regulations (CFR) Part 15 (47CFR15) Subpart C – Intentional Radiators 47CFR15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5875 MHz 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
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 FCC § 15.205	Applies	Pass
AC power line conducted emissions	FCC § 15.207	Applies	Pass

For Canada

Regulation / Test Standard	RSS-247 Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices Issue 2 February 2017 And, RSS-Gen — General Requirements for Compliance of Radio Apparatus Issue 5
-----------------------------------	---

Requirement	ISED Ragulation	Comments	Results Summary
Occupied Bandwidth	RSS-Gen 6.6	Applies	Pass
6 dB Bandwidth	ISED RSS-247 § 5.2	Applies	Pass
Maximum peak conducted power	ISED RSS-247 § 5.4	Applies	Pass
Power spectral density	ISED RSS-247 § 5.2	Applies	Pass
Band edge compliance	ISED RSS-247 § 3.3 and 5.5 RSS-GEN Issue 5 Section 8.10	Applies	Pass
Conducted spurious emissions	ISED RSS-247 § 5.5	Applies	Pass
Transmitter radiated spurious emissions	ISED RSS-GEN § 8.9	Applies	Pass
AC power line conducted emissions	ISED RSS-247 § 3.1	Applies	Pass

4.1 Knowledge Database References

The following KDBs were referenced during the testing of the CowAlert IceHub

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 CowAlert IceHub, as tested, was shown to meet requirements of the standards listed in Section 4 of this report.

Section 5 Spurious Emission Results – Radiated and Conducted

5.1 Test Specification

FCC Rule Part	47CFR 15.247 (d)
ISED Regulation	ISED RSS-247 § 5.5 and ISED RSS-GEN § 8.9
Standard	ANSI C63.10:2013
Measurement Uncertainty Radiated tests	The reported uncertainty of measurement $y \pm U$, 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	± 1.4 dB

5.2 Procedure and Test Software Version

Radiated tests: - 47CFR15.205 Restricted Bands Only

Eurofins York test procedure (30MHz to 1GHz)	CEP23b Issue 8
Eurofins York test procedure (1GHz to 40GHz)	CEP64b Issue 8
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 Date of Test

19th May 2021

5.3.3 Test Area

LAB 1 (SAC)

5.3.4 Tested by

M Render

5.3.5 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.

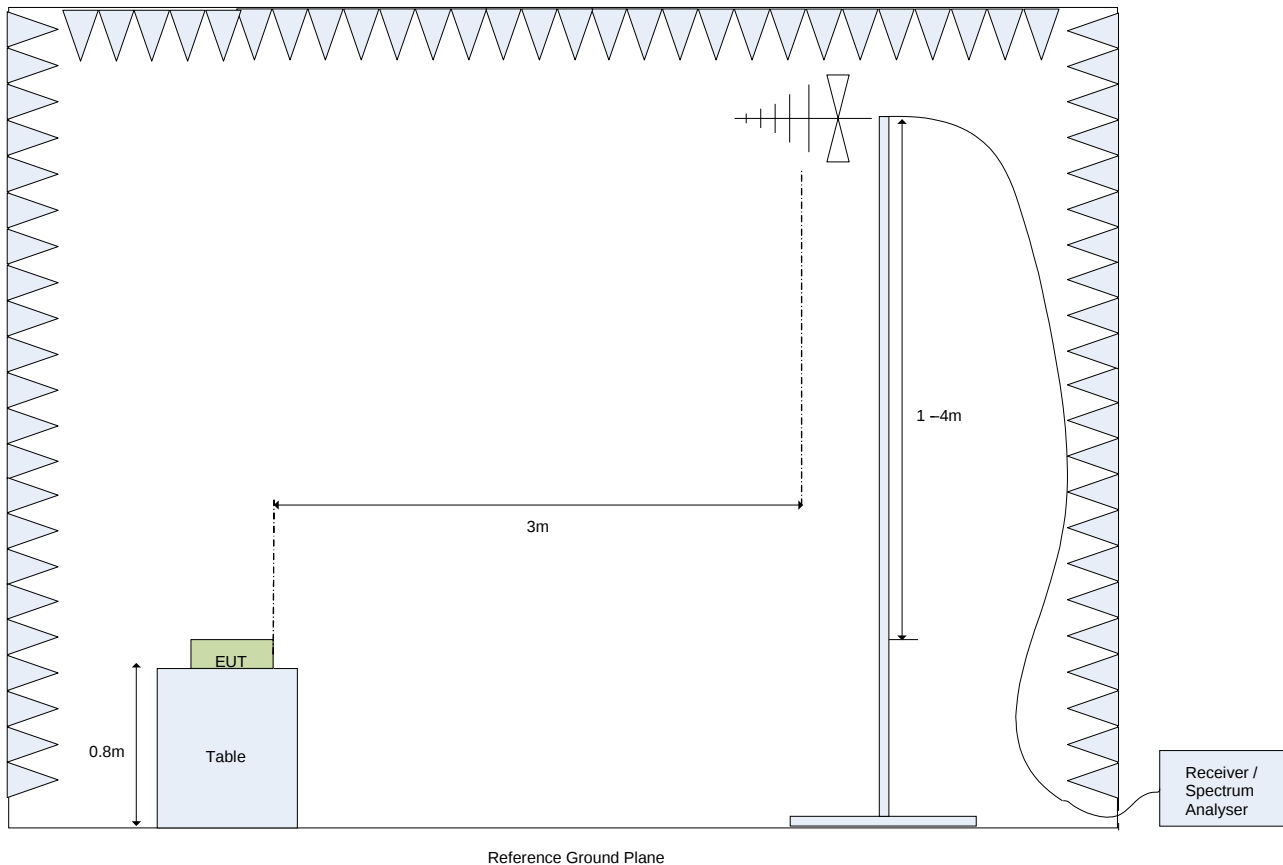


Figure 5.3.5.1: Test Setup for E-Field Measurements from 30MHz to 1GHz

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.

5.3.6 Electric field emissions, 30MHz to 1GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels for both different antenna configurations. Final measurements were performed with the equipment under test operating on the bottom channel with the ANT-868-CW-RAH and the middle channel with the WMO86916 antenna.



Figure 5.3.6.1: Electric field emissions Plot, 30MHz to 1GHz, ANT-868-CW-RAH Antenna - operation on Bottom Channel – Peak detector scan

Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBμV/m	dBμV/m	dB		degrees	m	
822.816	36.0	46.0	-10.0	Pass	10	1.0	Horizontal
941.658	32.6	46.0	-13.4	Pass	360	1.4	Horizontal
617.178	33.7	46.0	-12.3	Pass	185	1.3	Horizontal
801.384	28.6	46.0	-17.4	Pass	305	2.9	Horizontal
815.868	27.3	46.0	-18.7	Pass	130	3.8	Vertical
817.440	26.1	46.0	-19.9	Pass	355	3.2	Vertical

Table 5.3.6.1: Electric Field Emission Peaks, 30MHz to 1GHz, ANT-868-CW-RAH Antenna, operation on Bottom Channel

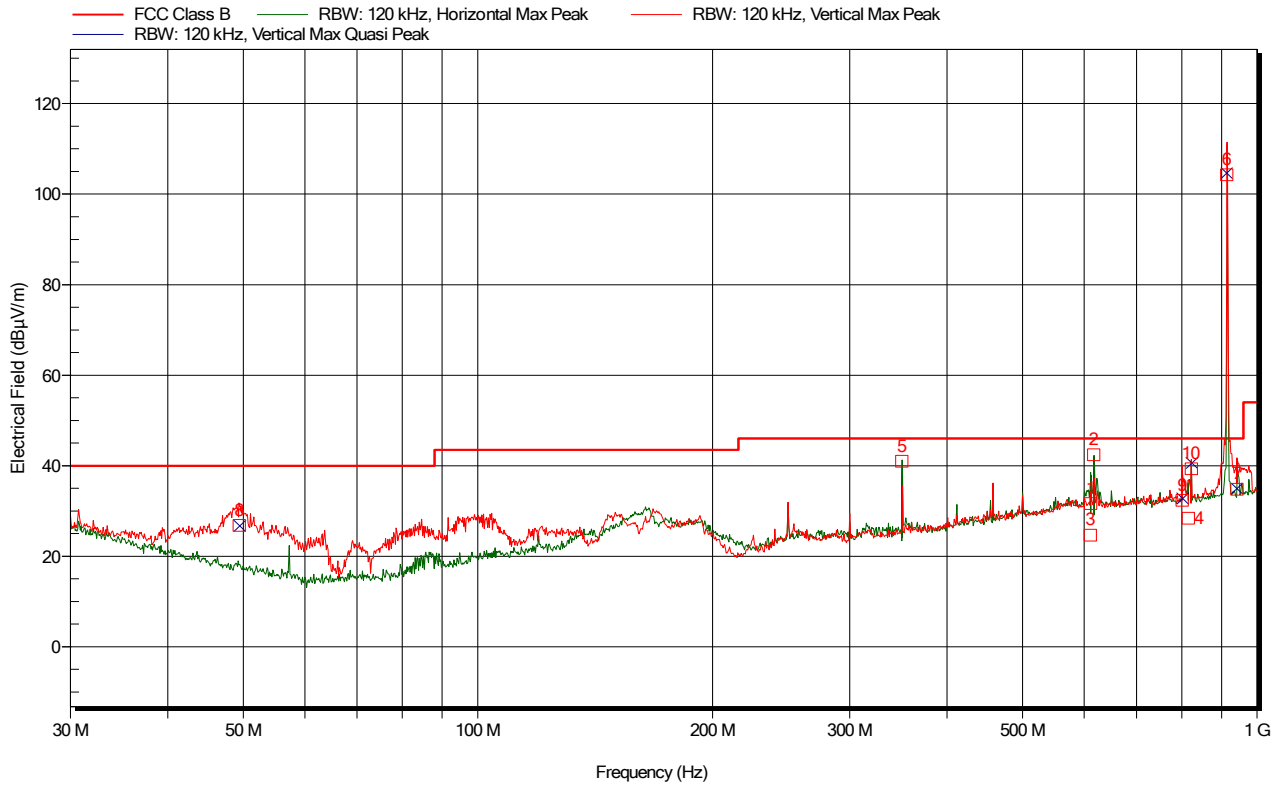


Figure 5.3.6.2: Electric field emissions Plot, 30MHz to 1GHz, WMO86916 Antenna - operation on Middle Channel - Peak detector scan

Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height	Polarization
MHz	dBµV/m	dBµV/m	dB		degrees	m	
611.562	31.6	46.0	-14.4	Pass	340	1.4	Horizontal
617.136	42.4	46.0	-3.6	Pass	340	1.4	Horizontal
610.872	24.6	46.0	-21.4	Pass	235	1.5	Horizontal
815.88	28.4	46.0	-17.6	Pass	275	1.7	Horizontal
349.992	41.0	46.0	-5.0	Pass	330	1.1	Horizontal
941.574	34.8	46.0	-11.2	Pass	180	1.0	Vertical
49.440	26.8	40.0	-13.2	Pass	140	1.0	Vertical
801.402	32.4	46.0	-13.6	Pass	359	2.7	Vertical
822.852	39.3	46.0	-6.7	Pass	44	1.5	Vertical

Table 5.3.6.2: Electric Field Emission Peaks, 30MHz to 1GHz, WMO86916 Antenna - operation on Middle Channel



Figure 5.3.6.3: Electric field emissions Plot, 30MHz to 1GHz, ANT-868-CW-RAH Antenna - operation on Middle Channel - Peak detector scan

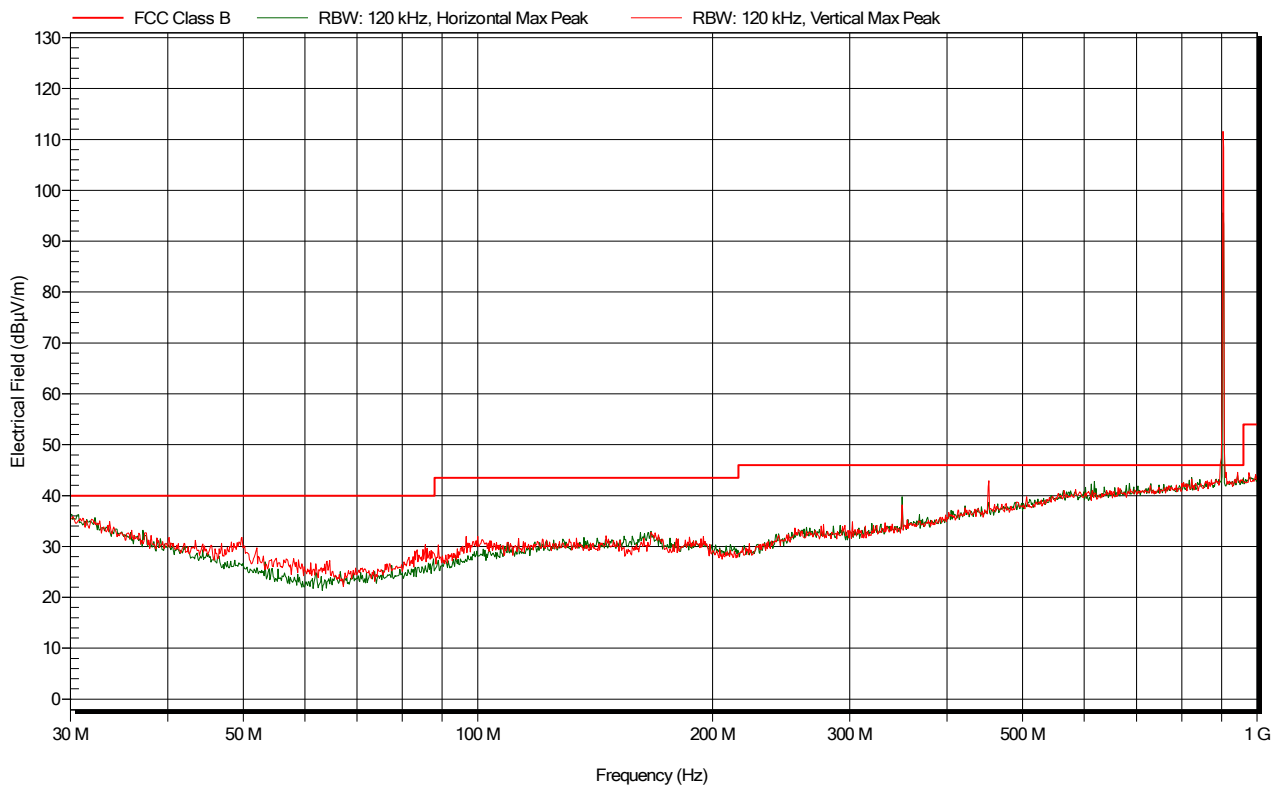


Figure 5.3.6.4: Electric field emissions Plot, 30MHz to 1GHz, WMO86916 Antenna - operation on Bottom Channel - Peak detector scan

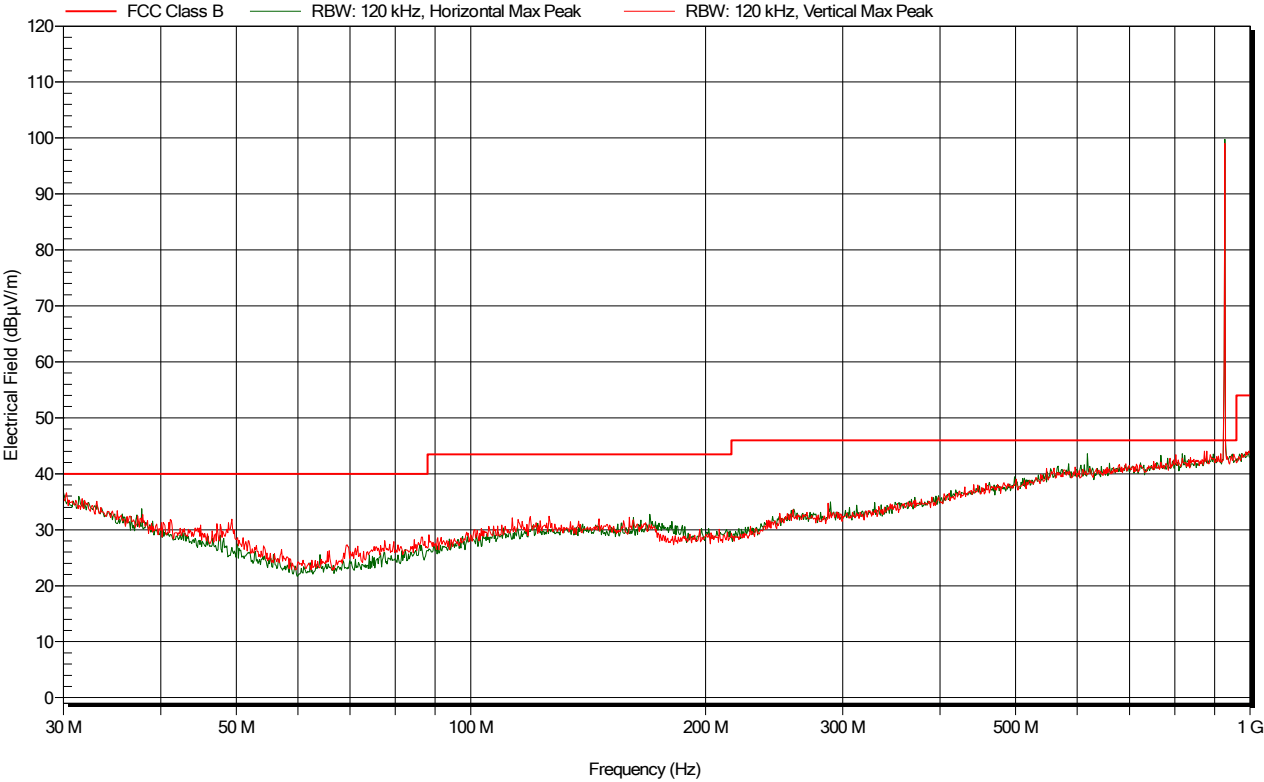


Figure 5.3.6.5: Electric field emissions Plot, 30MHz to 1GHz, ANT-868-CW-RAH Antenna - operation on Top Channel - Peak detector scan

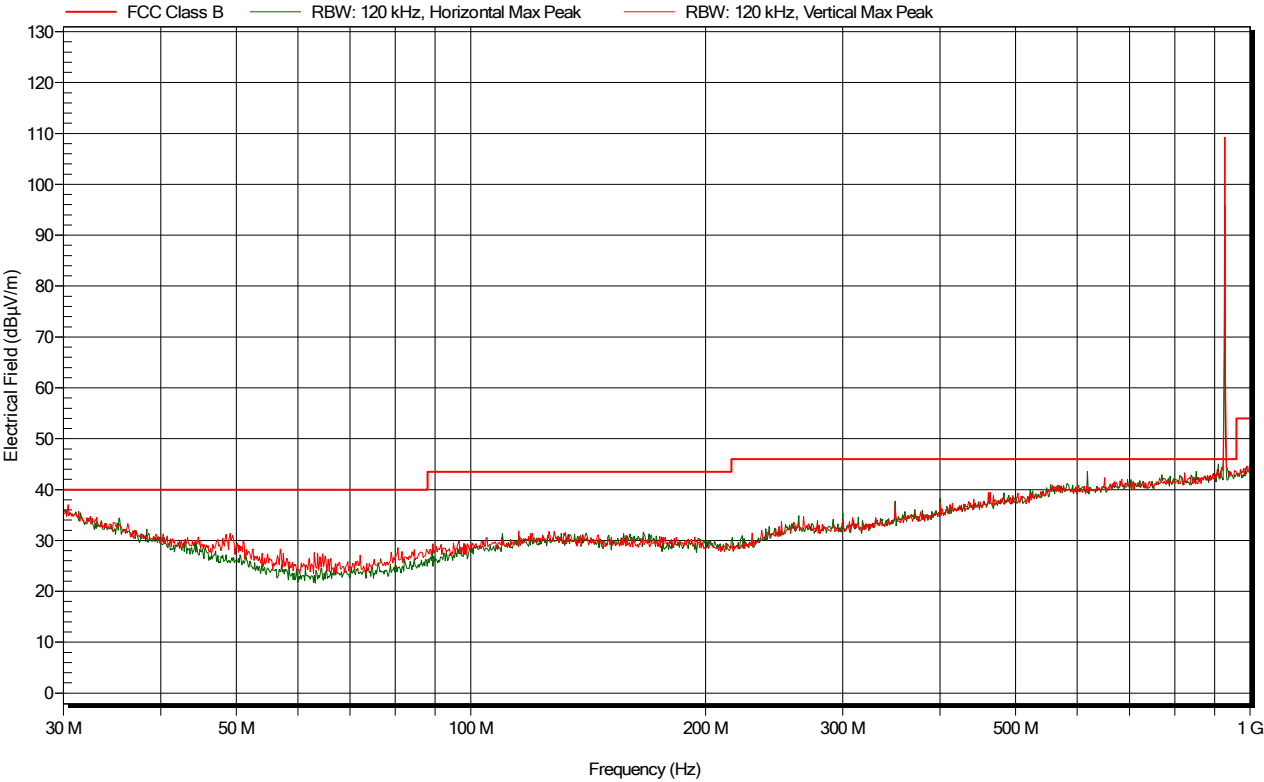


Figure 5.3.6.6: Electric field emissions Plot, 30MHz to 1GHz, WMO86916 Antenna - operation on Top Channel - Peak detector scan

5.3.7 Example field strength calculation

Field strength (FS) is calculated as follows:

$$\text{FS (dB}\mu\text{V/m)} = \text{Indicated Signal Level (dB}\mu\text{V)} + \text{AF (dB/m)} + \text{CL (dB)}$$

5.3.8 Sample Data

From Figure 5.3.6.1, table 5.3.6.1, the Quasi-Peak level at 822.816 MHz is calculated as follows:

$$\text{FS (dB}\mu\text{V/m)} = 7.3 \text{ (dB}\mu\text{V)} + 25.7 \text{ (dB/m)} + 3.0 \text{ (dB)} = 36.0 \text{ dB}\mu\text{V/m}$$

5.4 Radiated Emissions (1GHz to 10GHz)**5.4.1 Limits**

Frequency (GHz)	Limit (dBµV/m)	Limit (dBµV/m)
	Peak	Average
1-10	74.0	54.0

5.4.2 Receiver Settings

Receiver Parameters	Setting
Detector Function	Average and Peak
Start Frequency	1GHz
Stop Frequency	10GHz
Resolution Bandwidth	1MHz
Video Bandwidth	Auto

5.4.3 Date of Test19th May 2021**5.4.4 Test Area**

LAB 1 (SAC)

5.4.5 Tested by

M Render

5.4.6 Test Setup

The EUT was configured in the SAC on an 1.5m high table. Exploratory measurements on the EUT were carried out to identify suspect frequencies and worst case orientations, see Section 5.4.7.

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.

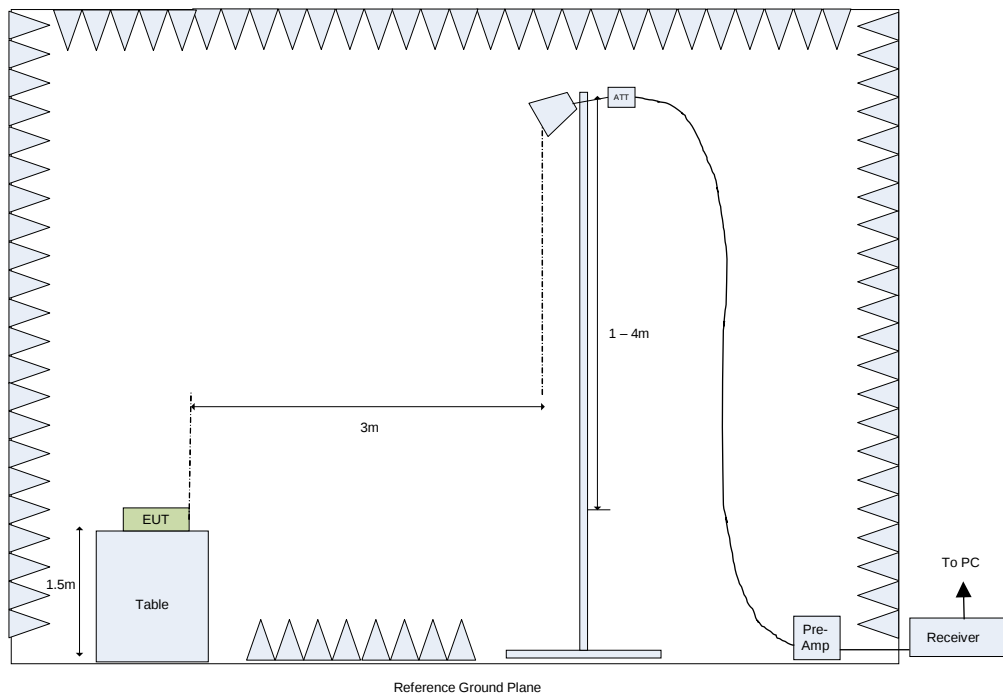


Figure 5.4.6.1: Test Setup for Final E-Field Measurements from 1GHz to 10GHz

Note 1 : With the EUT de-energized the ambient radio noise and signals met the 6dB peak detection requirement of ANSI C63.4-2010.

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.

5.4.7 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)	EUT face *	Emissions Angle (w.r.t. turntable)	Height	Polarization
2.8	Side face	-	-	Vertical
2.8	Side face	-	-	Horizontal

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 equipment was operated on all 3 channels with both antenna options. The same frequencies were identified for each channel and antenna.

5.4.8 Electric field emissions, 1GHz to 10GHz

The equipment under test was pre-scanned using peak detection when operating on all three channels for both different antenna configurations. Final measurements were performed with the equipment under test operating on all the same modes.

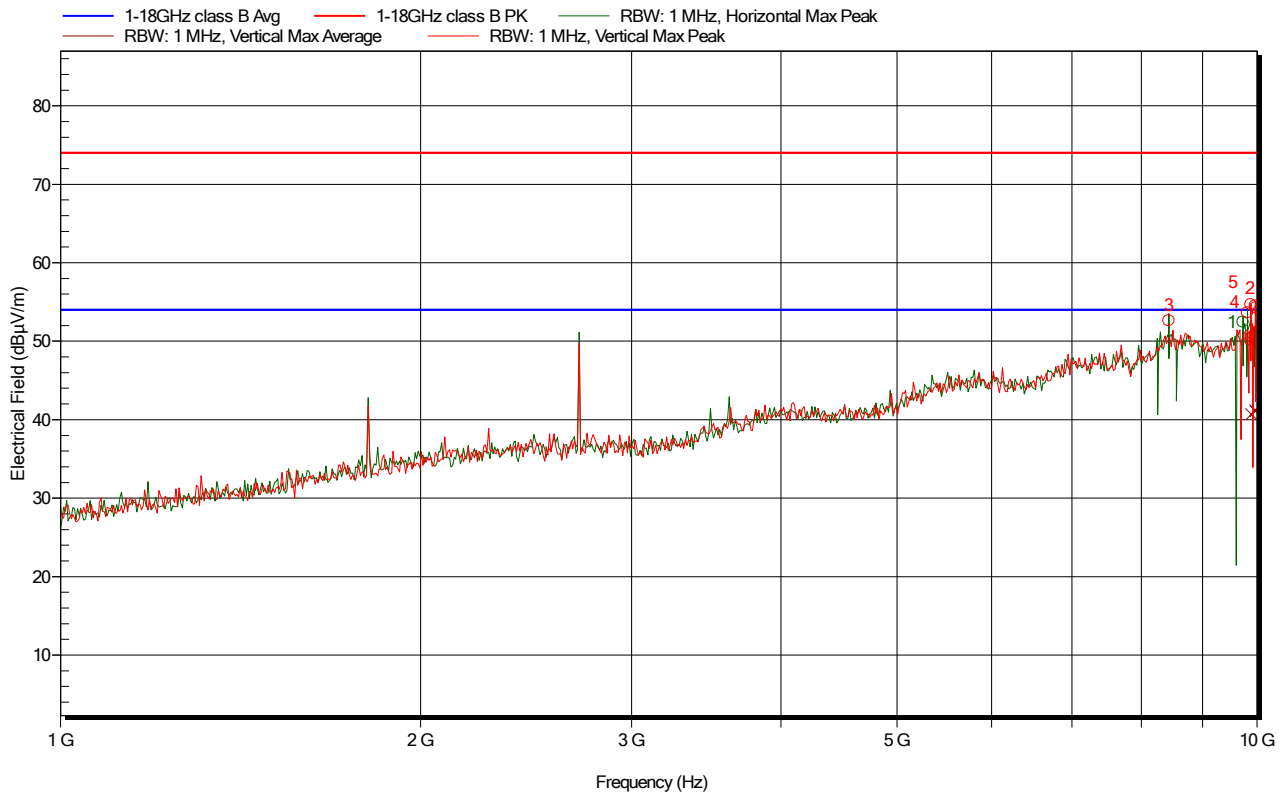


Figure 5.4.8.1: Electric field emissions Plot, 1GHz to 10GHz. ANT-868-CW-RAH Antenna - Operation on Bottom Channel – Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
9.731 GHz	39.39 dBμV/m	54 dBμV/m	-14.61 dB	Pass	40 degrees	2.6	Horizontal
9.97 GHz	41.08 dBμV/m	54 dBμV/m	-12.92 dB	Pass	140 degrees	1.7	Vertical
8.439 GHz	39.27 dBμV/m	54 dBμV/m	-14.73 dB	Pass	155 degrees	1.8	Horizontal
9.813 GHz	40.26 dBμV/m	54 dBμV/m	-13.74 dB	Pass	215 degrees	2.1	Horizontal
9.879 GHz	40.74 dBμV/m	54 dBμV/m	-13.26 dB	Pass	295 degrees	3.3	Vertical
9.964 GHz	41.22 dBμV/m	54 dBμV/m	-12.78 dB	Pass	325 degrees	1.0	Vertical

Table 5.4.8.1: Electric Field Emissions Peaks, 1GHz to 10GHz – ANT-868-CW-RAH Antenna - Operation on Bottom Channel

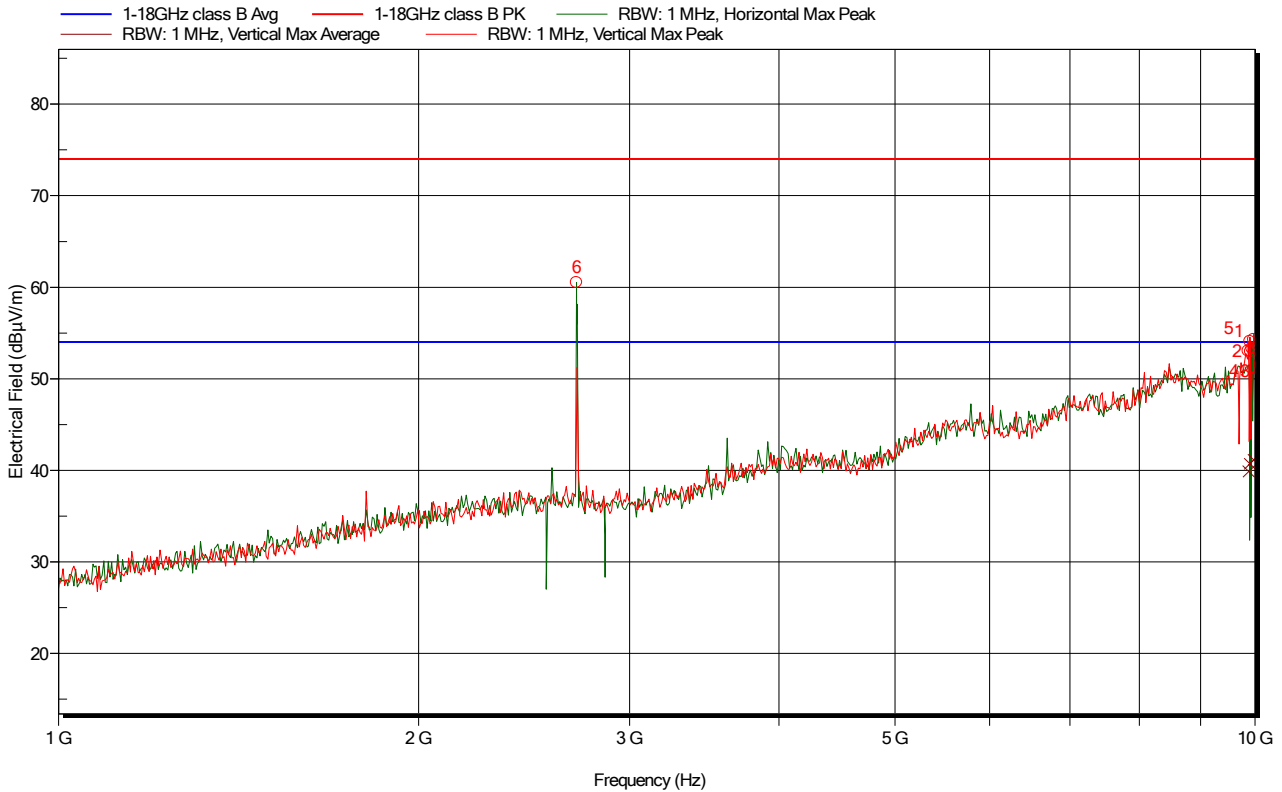


Figure 5.4.8.2: Electric field emissions Plot, 1GHz to 10GHz, WMO86916 Antenna - Operation on Bottom Channel - Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
9.902	40.70	54.0	-13.30	Pass	25	3.0	Vertical
9.869	39.93	54.0	-14.07	Pass	115	1.2	Vertical
9.914	39.11	54.0	-14.89	Pass	120	2.7	Horizontal
9.935	40.36	54.0	-13.64	Pass	235	3.1	Horizontal
9.968	41.15	54.0	-12.85	Pass	255	2.2	Vertical
2.710	53.39	54.0	-0.61	Pass	250	1.0	Horizontal

Table 5.4.8.2: Electric Field Emissions Peaks, 1GHz to 10GHz – WMO86916 Antenna - Operation on Bottom Channel

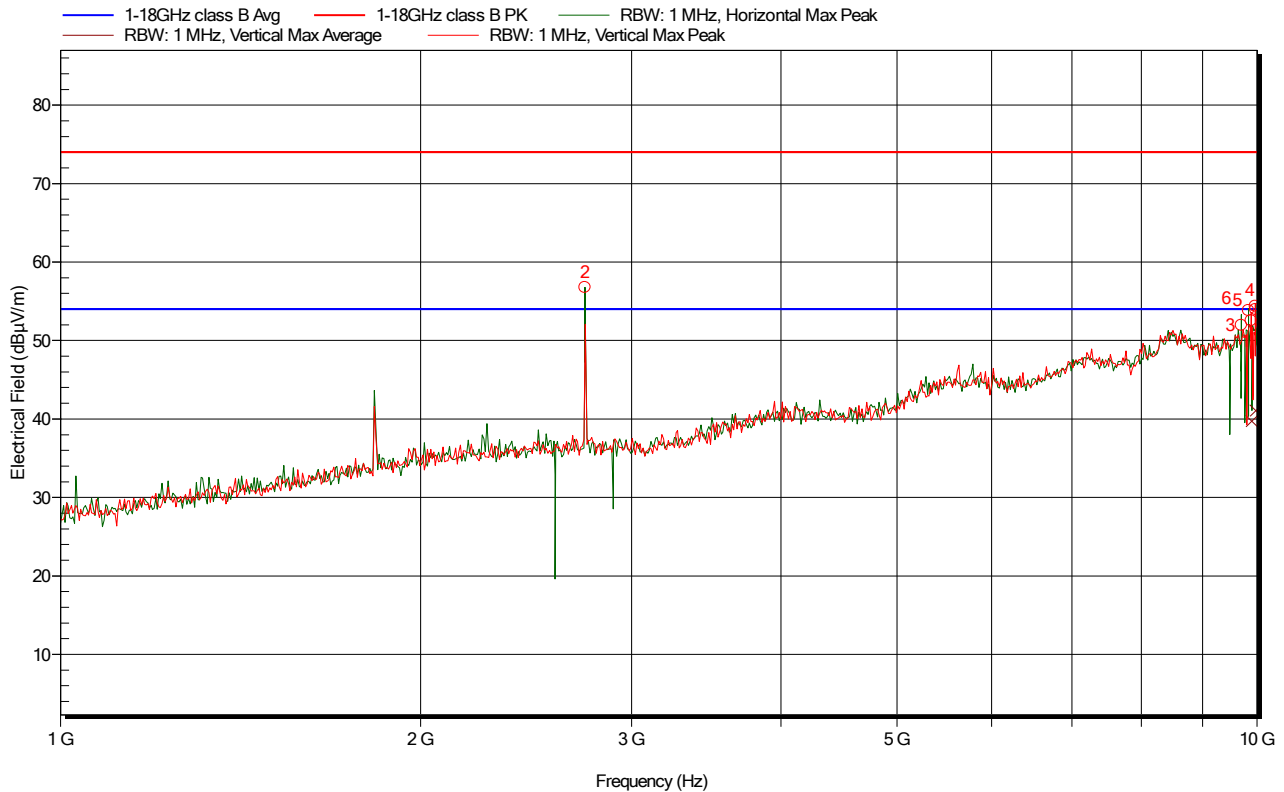


Figure 5.4.8.3: Electric field emissions Plot, 1GHz to 10GHz, ANT-868-CW-RAH Antenna - Operation on Middle Channel – Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
9.886	39.79	54.0	-14.21	Pass	55	1.0	Vertical
2.744	49.44	54.0	-4.56	Pass	120	2.4	Horizontal
9.698	39.16	54.0	-14.84	Pass	120	3.8	Horizontal
9.964	41.12	54.0	-12.88	Pass	160	1.5	Vertical
9.831	40.14	54.0	-13.86	Pass	255	3.3	Horizontal
9.972	40.97	54.0	-13.03	Pass	255	1.8	Horizontal

Table 5.4.8.3: Electric Field Emissions Peaks, 1GHz to 10GHz – ANT-868-CW-RAH Antenna - Operation on Middle Channel

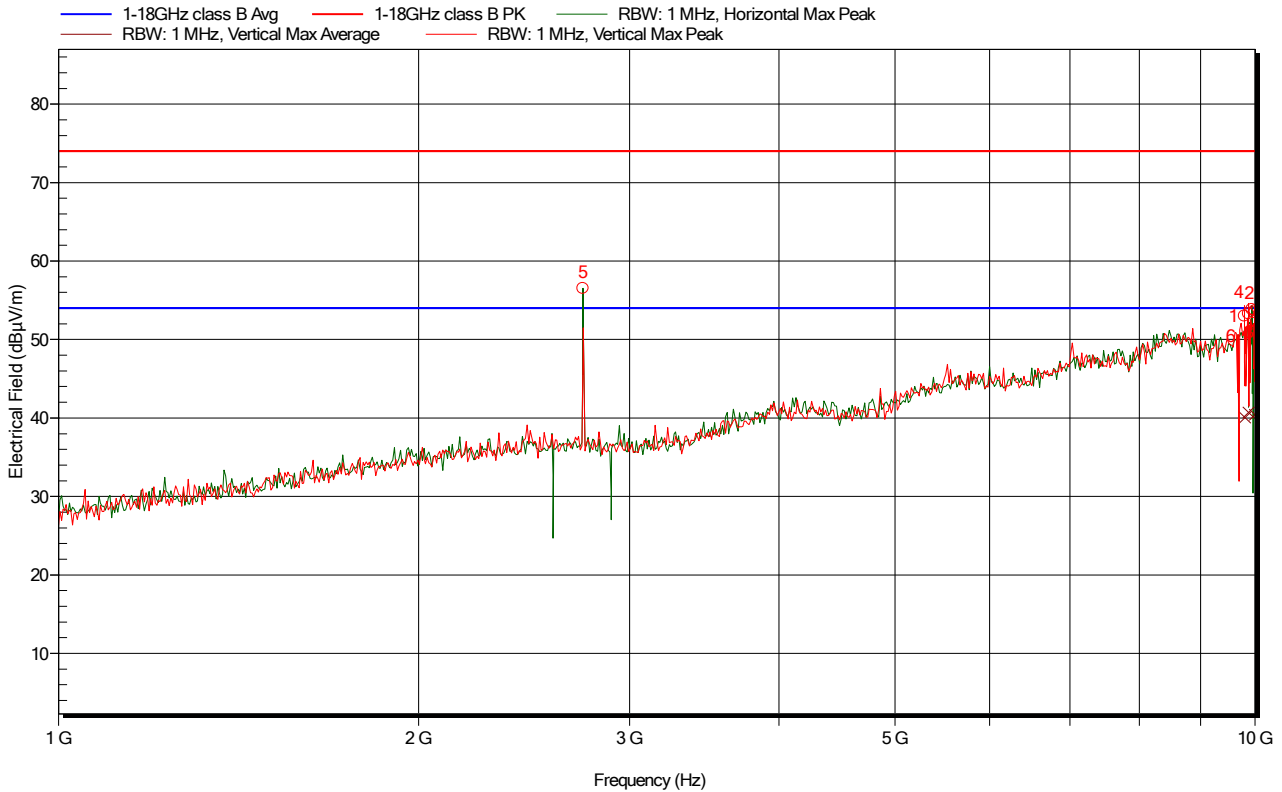


Figure 5.4.8.4: Electric field emissions Plot, 1GHz to 10GHz, WMO86916 Antenna - Operation on Middle Channel – Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
9.799	40.12	54.0	-13.88	Pass	80	3.7	Vertical
9.997	40.43	54.0	-13.57	Pass	55	3.8	Vertical
9.988	40.14	54.0	-13.86	Pass	145	2.4	Horizontal
9.941	40.74	54.0	-13.26	Pass	185	3.1	Horizontal
2.743	50.12	54.0	-3.88	Pass	250	1.0	Horizontal
9.876	40.70	54.0	-13.30	Pass	290	3.9	Vertical

Table 5.4.8.4: Electric Field Emissions Peaks, 1GHz to 10GHz – WMO86916 Antenna - Operation on Middle Channel

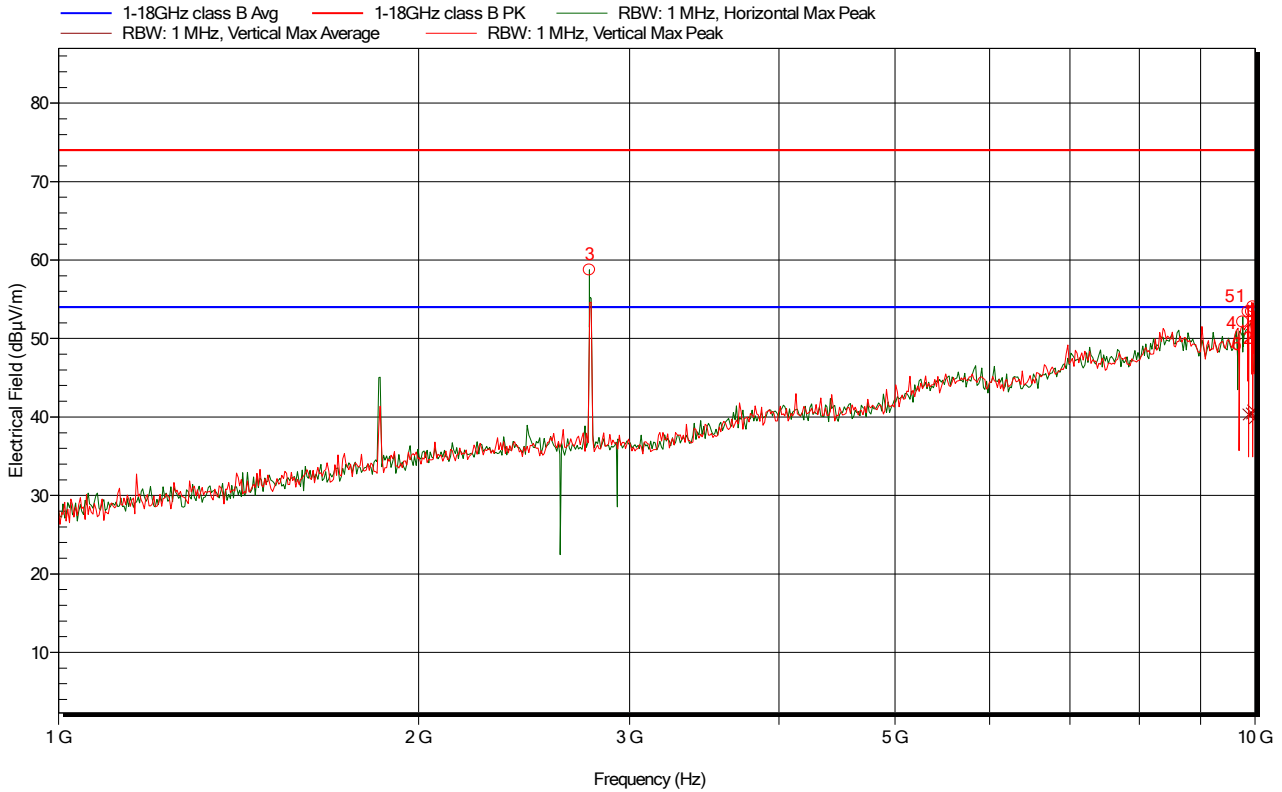


Figure 5.4.8.5: Electric field emissions Plot, 1GHz to 10GHz, ANT-868-CW-RAH Antenna - Operation on Top Channel – Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
9.931	40.51	54.0	-13.49	Pass	360	3.0	Vertical
9.985	39.92	54.0	-14.08	Pass	10	2.5	Vertical
2.778	51.23	54.0	-2.77	Pass	120	2.6	Horizontal
9.864	40.38	54.0	-13.62	Pass	210	3.8	Vertical
9.960	40.86	54.0	-13.14	Pass	265	2.3	Vertical
9.762	38.96	54.0	-15.04	Pass	335	3.1	Horizontal

Table 5.4.8.5: Electric Field Emissions Peaks, 1GHz to 10GHz – ANT-868-CW-RAH Antenna - Operation on Top Channel

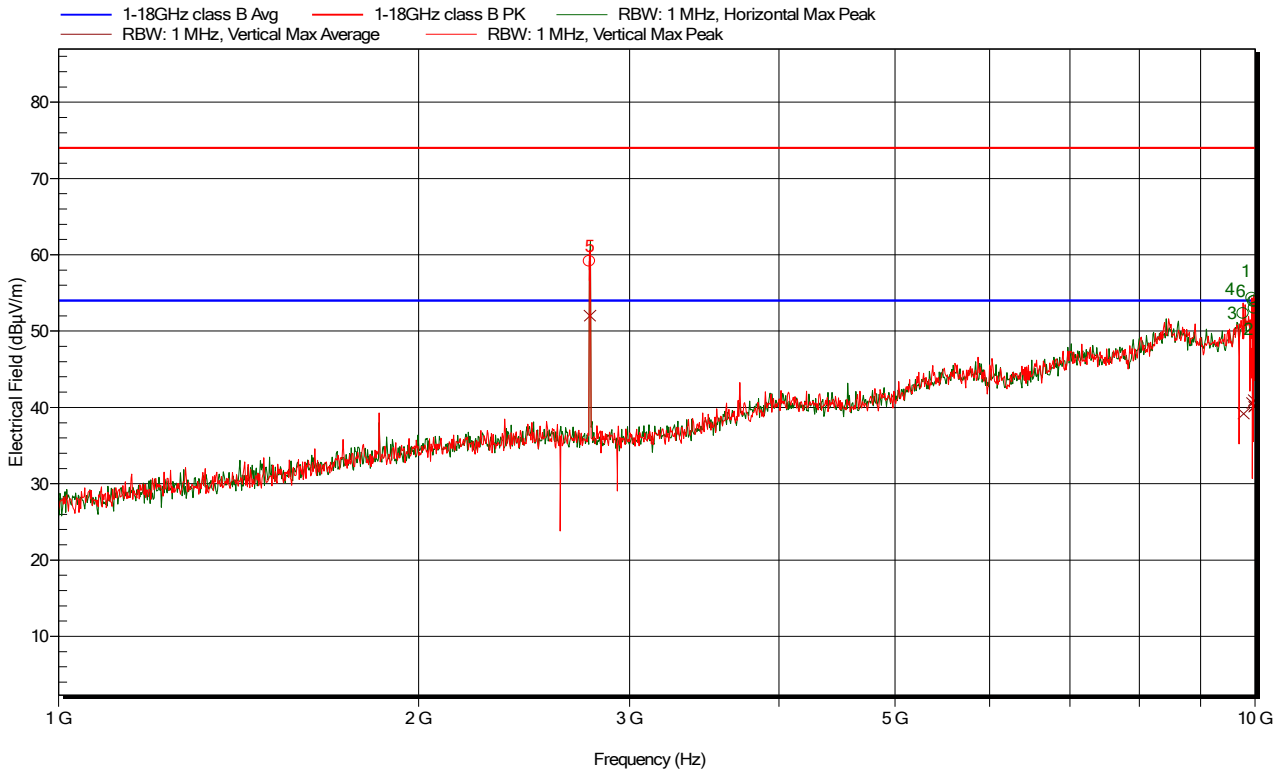


Figure 5.4.8.6: Electric field emissions Plot, 1GHz to 10GHz, WMO86916 Antenna - Operation on Top Channel – Peak detector scan

Frequency	Average	Average Limit	Average Difference	Average Status	Angle	Height	Polarization
GHz	dBμV/m	dBμV/m	dB		degrees	m	
2.779	52.07	54.0	-1.93	Pass	215	1.0	Vertical
9.772	39.23	54.0	-14.77	Pass	45	1.2	Vertical
9.968	41.00	54.0	-13.00	Pass	280	1.5	Vertical
9.996	40.20	54.0	-13.80	Pass	60	1.2	Vertical
9.985	40.06	54.0	-13.94	Pass	20	1.0	Vertical
9.940	40.64	54.0	-13.36	Pass	350	2.0	Vertical

Table 5.4.8.6: Electric Field Emissions Peaks, 1GHz to 10GHz – WMO86916 Antenna - Operation on Top Channel

5.4.9 Example field strength calculation

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:

$$\text{FS (dB}\mu\text{V/m)} = \text{Indicated Signal Level (dB}\mu\text{V)} - \text{PG (dB)} + \text{AF (dB)} + \text{AL (dB)} + \text{CL (dB)}$$

5.4.10 Sample Data

From Figure 5.4.8.1 and table 5.4.8.1, The Average level at 9.731 GHz is calculated as follows:

$$\text{FS (dB}\mu\text{V/m)} = 38.37 \text{ (dB}\mu\text{V)} - 51.64 \text{ (dB)} + 40.76 \text{ (dB/m)} + 11.90 \text{ (dB)} = 39.39 \text{ dB}\mu\text{V/m}$$

5.5 Conducted Spurious Emissions 30MHz to 10GHz**5.5.1 Limits**

Frequency (MHz)	Limit, 47CFR 15.247(d)
	Peak
30 – 10000	20dBc

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

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

5.5.2 Date of Test

16th March 2021

5.5.3 Test Area

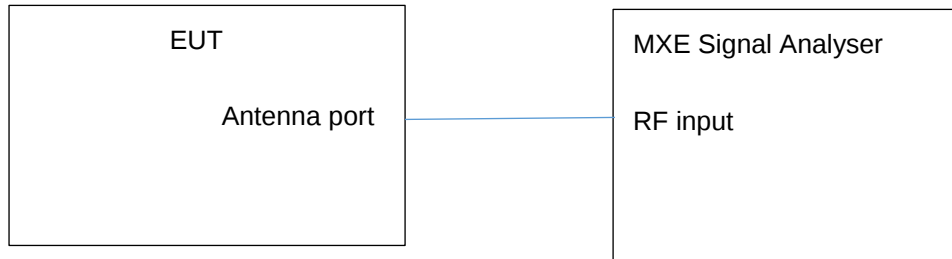
LAB 7

5.5.4 Tested by

M Render

5.5.5 Test Setup

The antenna port was connected directly to the signal analyser.

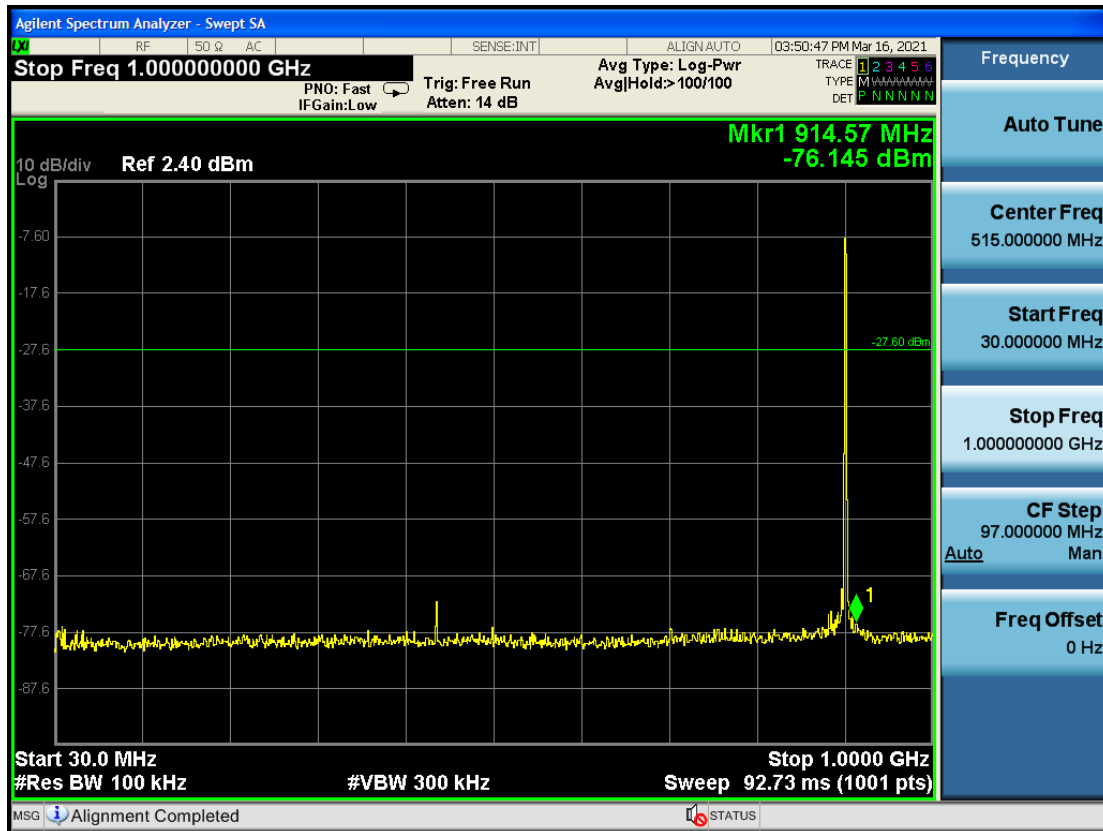


5.5.6 Test Results

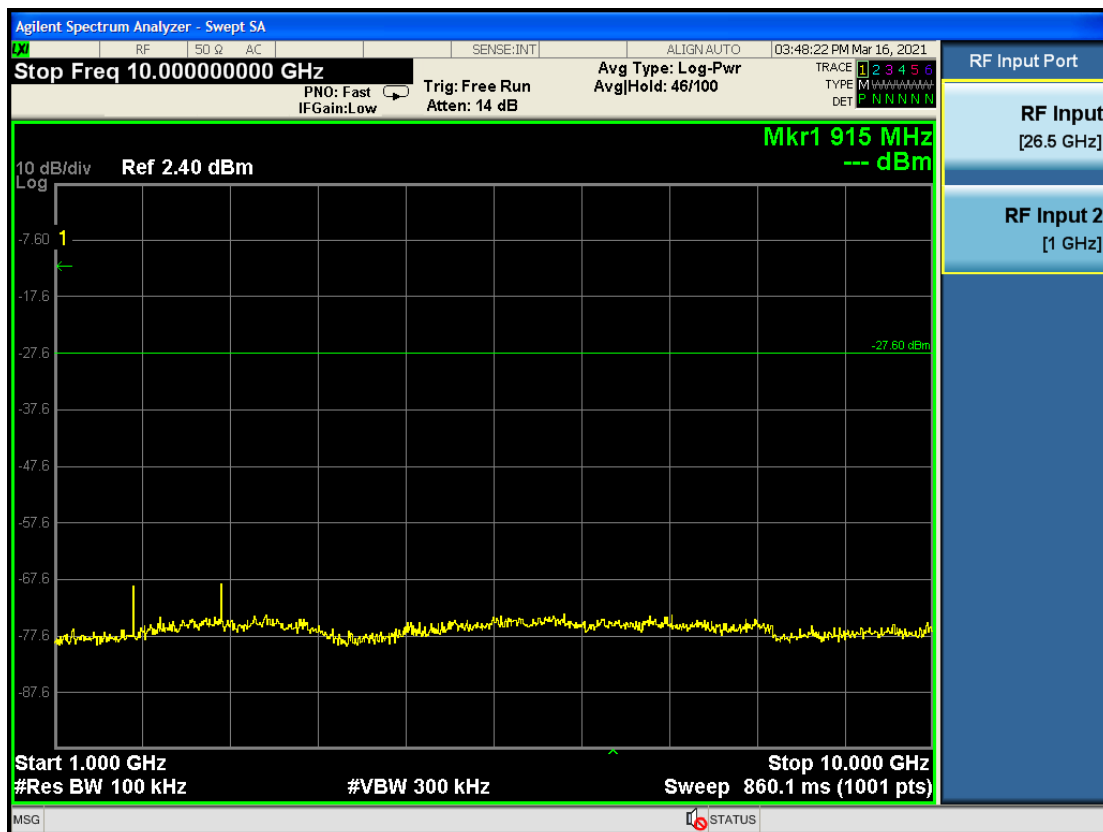
The results of the conducted spurious emissions are stated below and by the signal analyser images.

All disturbances detected were > 20dB below the carrier.

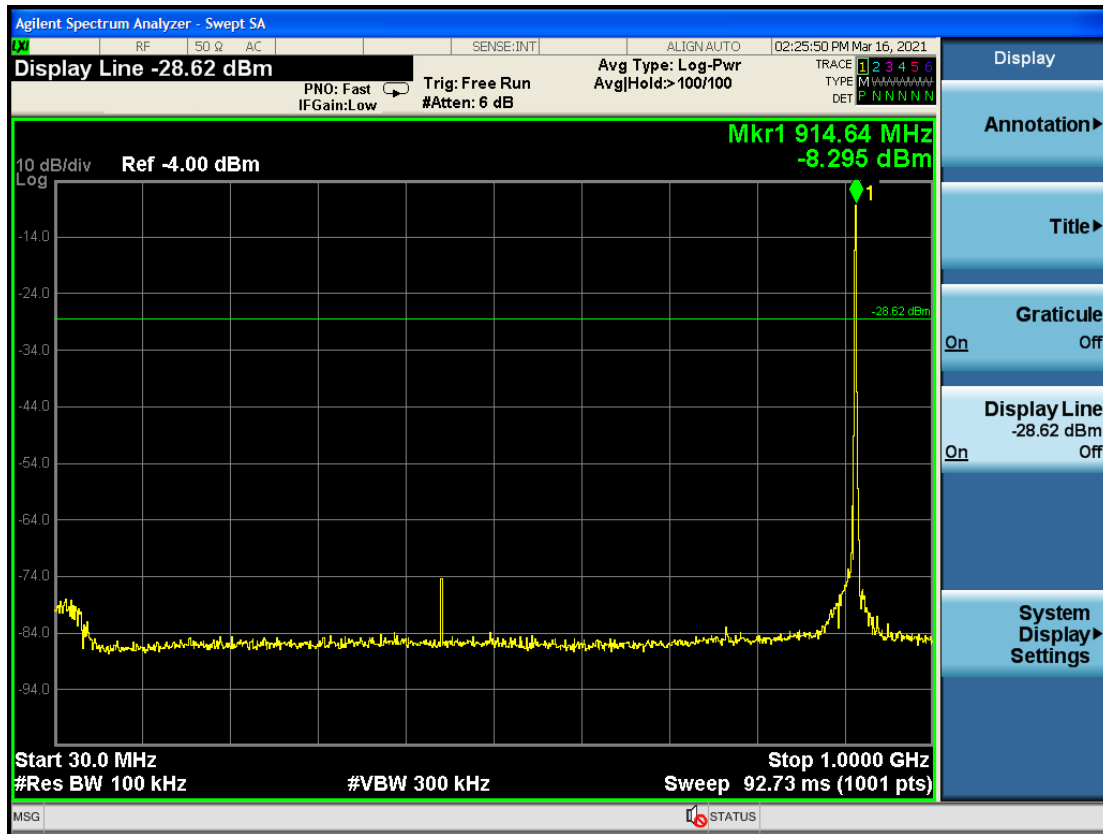
Antenna port conducted emissions 30MHz to 10GHz



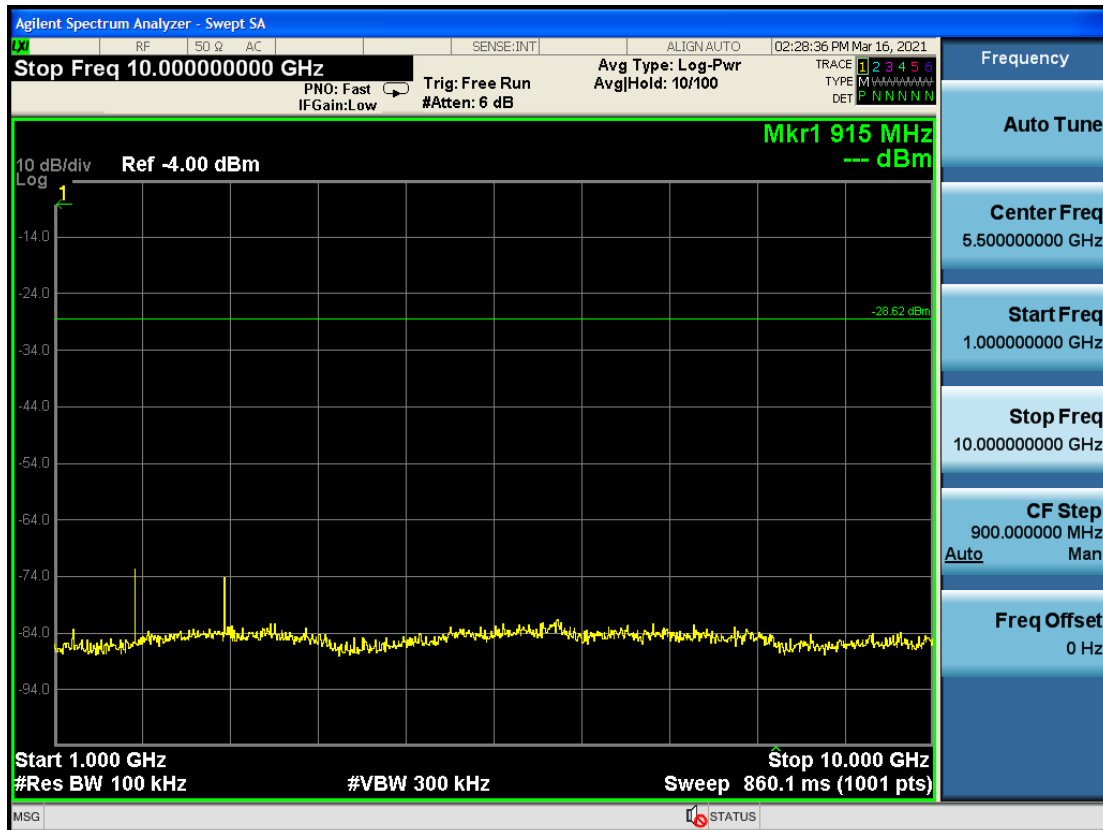
Conducted emissions 30MHz to 1GHz. Operation on Bottom channel.



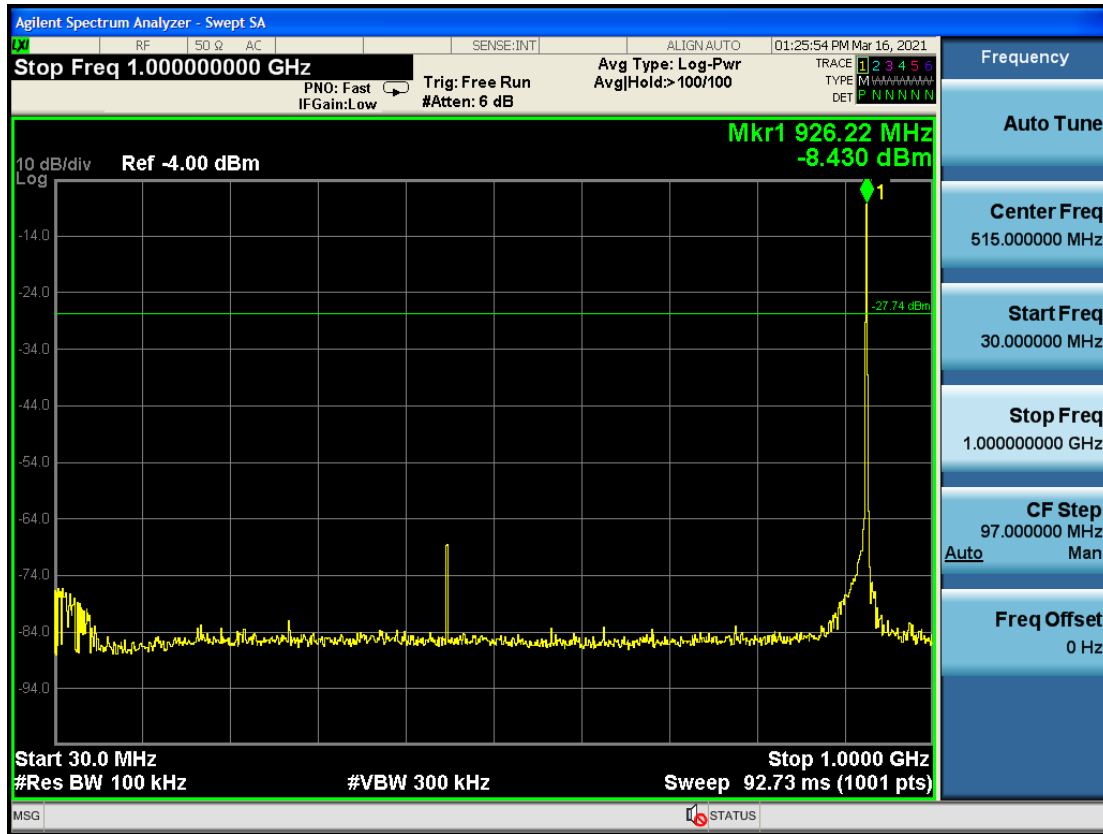
Conducted emissions 1GHz to 10GHz. Operation on Bottom channel.



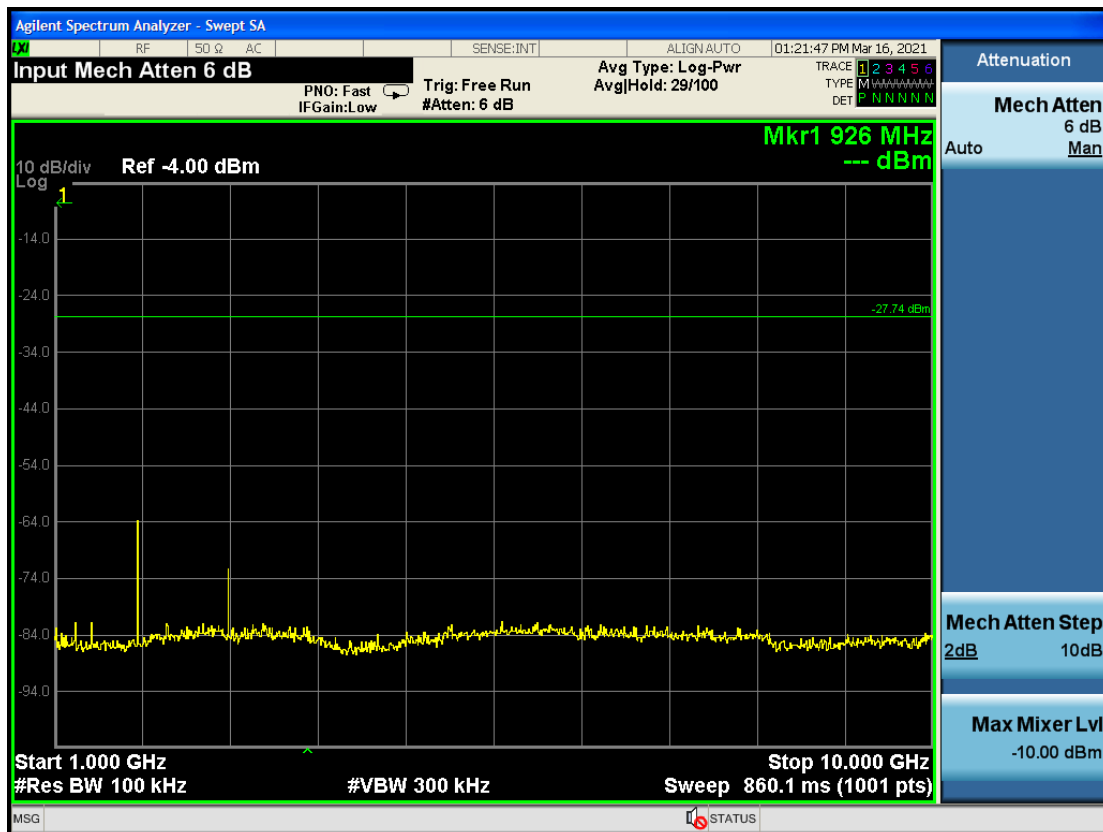
Conducted emissions 30MHz to 1GHz. Operation on Middle channel.



Conducted emissions 1GHz to 10GHz. Operation on Middle channel.



Conducted emissions 30MHz to 1GHz. Operation on Top channel.



Conducted emissions 1GHz to 10GHz. Operation on Top channel.

Section 6 6dB Bandwidth and 99% Occupied Bandwidth

6.1 Test Specification

FCC Rule Part	47CFR 15.247 (a)(2)
ISED Regulation	ISED RSS-247 § 5.2 and RSS-Gen 6.6
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(a)(2)
	Peak
2400MHz to 2483.5MHz	At least 500kHz

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.8.1

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 Date of Test16th March 2021**6.2.2 Test Area**

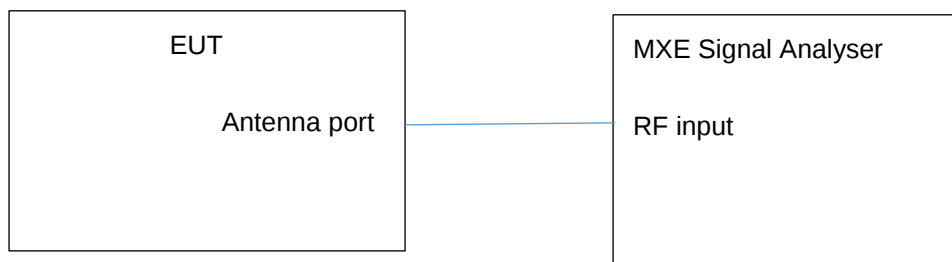
LAB 7

6.2.3 Tested by

M Render

6.2.4 Test Setup

The antenna port was connected directly to the signal analyser.

**6.3 Test Results**

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

Channel (MHz)	Modulation scheme	Measured 6dB bandwidth (kHz)	Minimum requirement (kHz)	99% Occupied bandwidth (kHz)	Figure	Result
903.2	WB-DSSS	541.8	500.0	763.52	6.3.1	Pass
914.4	WB-DSSS	530.4	500.0	729.23	6.3.2	Pass
926.3	WB-DSSS	548.3	500.0	695.08	6.3.3	Pass

6dB and 99% Bandwidth Measurements

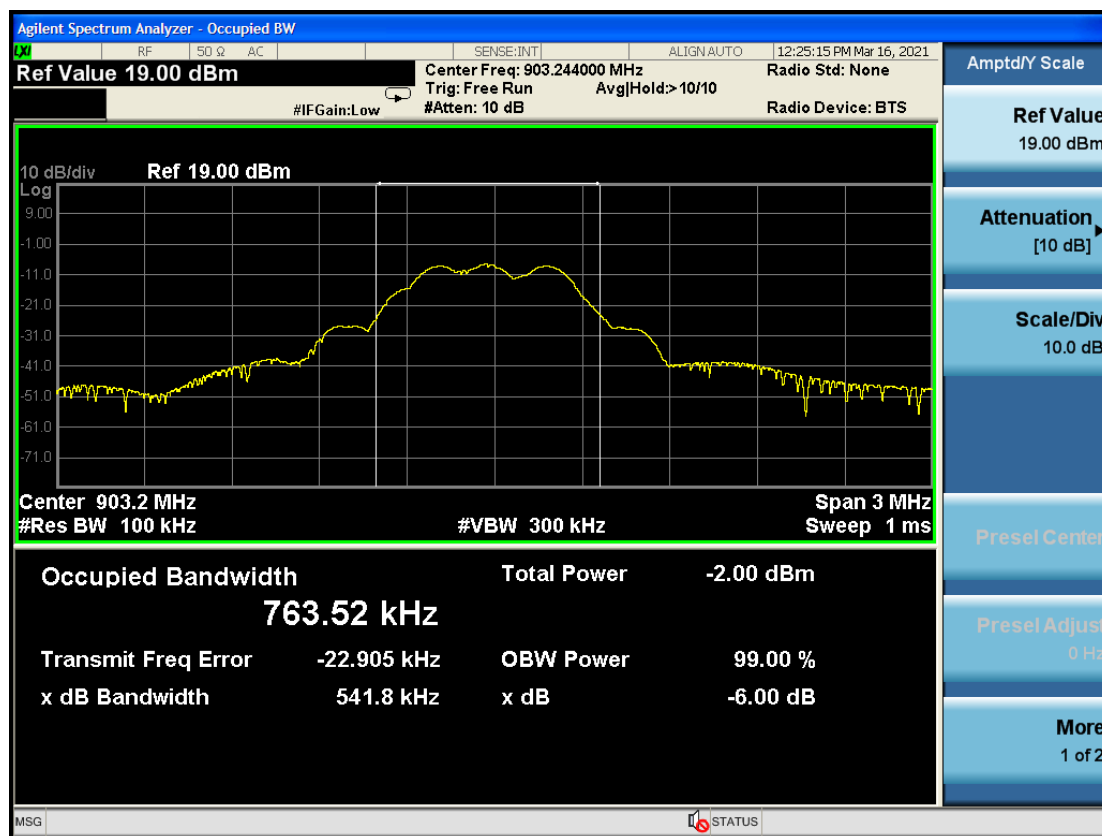


Figure 6.3.1 Bandwidth at 6dB Point. Operation on Bottom Channel



Figure 6.3.2 Bandwidth at 6dB Point. Operation on Middle Channel

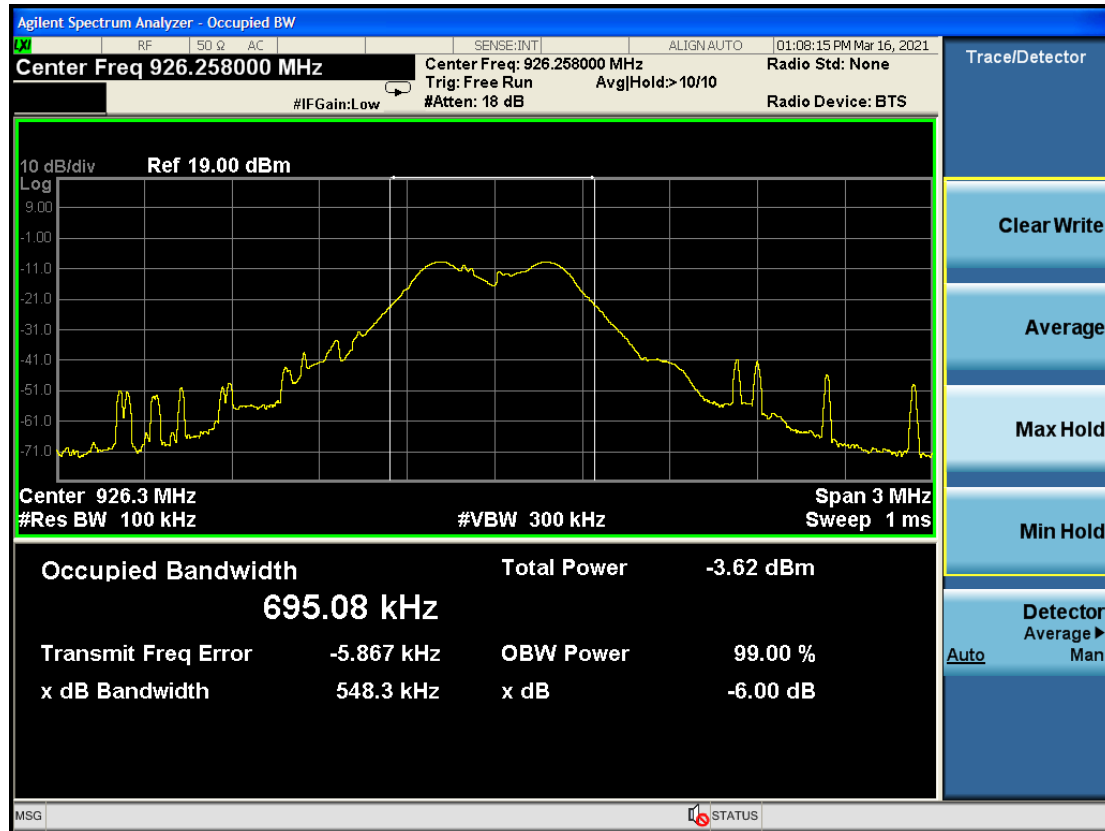


Figure 6.3.3 Bandwidth at 6dB Point. Operation on Top Channel

Section 7 Peak Output Power

7.1 Test Specification

FCC Rule Part	47CFR 15.247 (b)(3)
ISED Regulation	ISED RSS-247 § 5.4
Standard	ANSI C63.10:2013

7.2 Procedure and Test Software Version

Conducted Tests

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

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

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.9.1.1

Receiver Parameters	Setting
Detector Function	Peak
Span	[3 x RBW]
Resolution Bandwidth	1MHz
Video Bandwidth	3MHz
Sweep rate	Auto couple
Trace mode	Max hold
Integration Bandwidth	[DTS bandwidth]

7.2.1 Date of Test16th March 2021**7.2.2 Test Area**

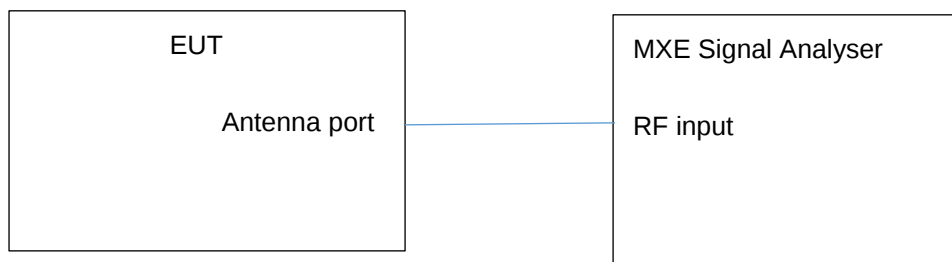
LAB 7

7.2.3 Tested by

M Render

7.2.4 Test Setup

The antenna port was connected directly to the signal analyser.

**7.3 Test Result**

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

Channel (MHz)	Modulation scheme	Peak output power (mW)	Limit (Watts)	Figure
903.2	WB-DSSS	0.171	1.0	7.3.1
914.4	WB-DSSS	0.176	1.0	7.3.2
926.3	WB-DSSS	0.175	1.0	7.3.3

Peak Output Power Measurement

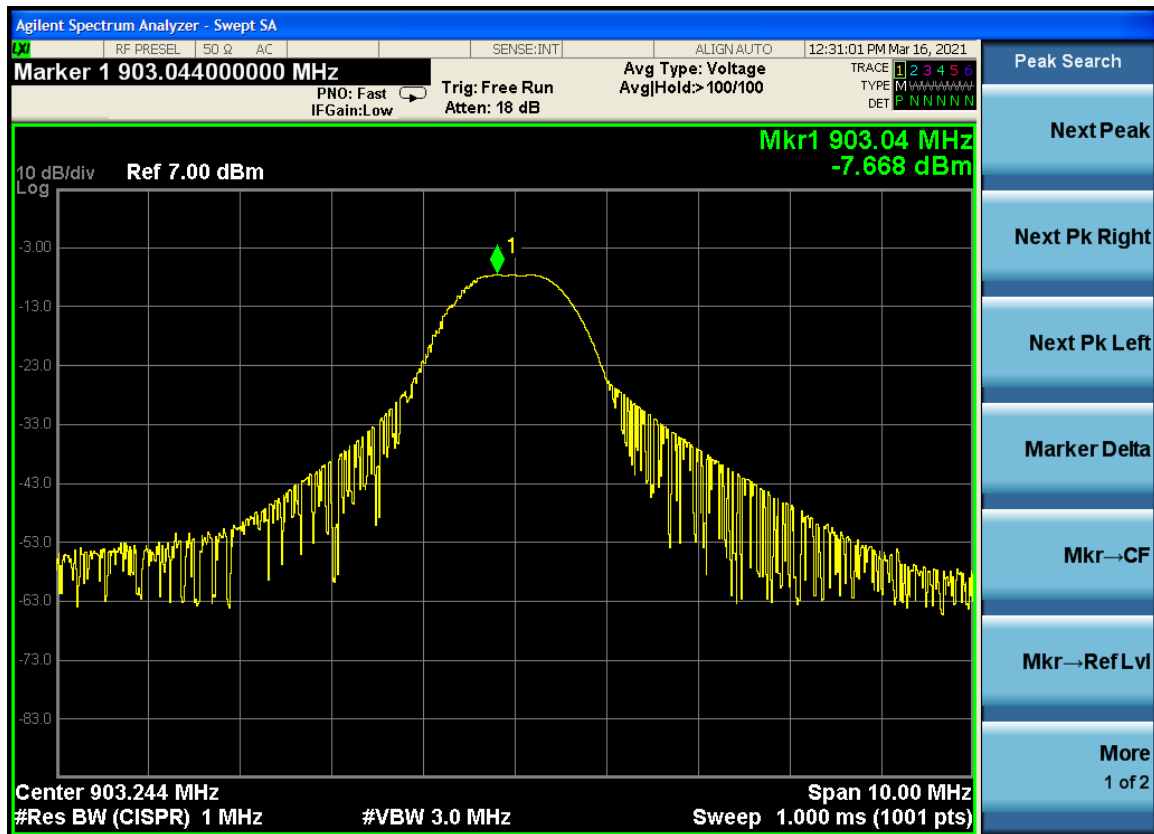


Figure 7.3.1 Peak output power. Operation on Bottom channel

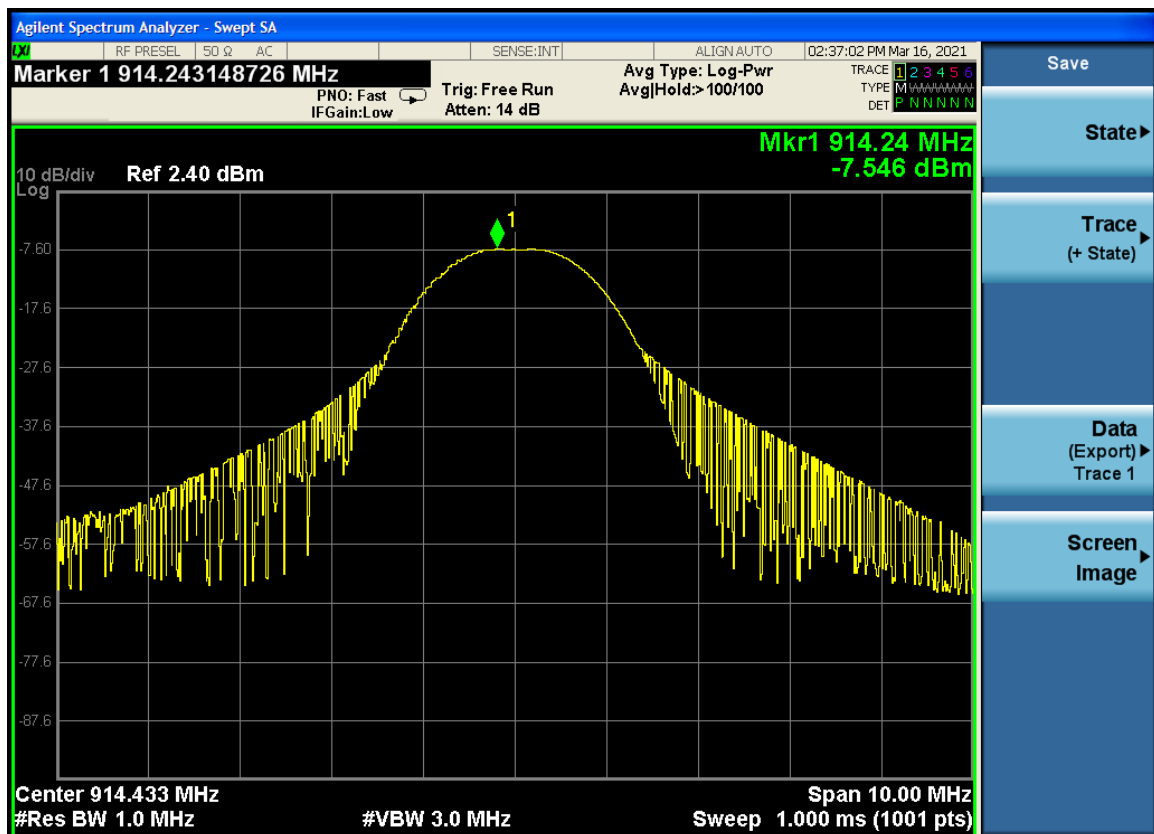


Figure 7.3.2 Peak output power. Operation on Middle channel

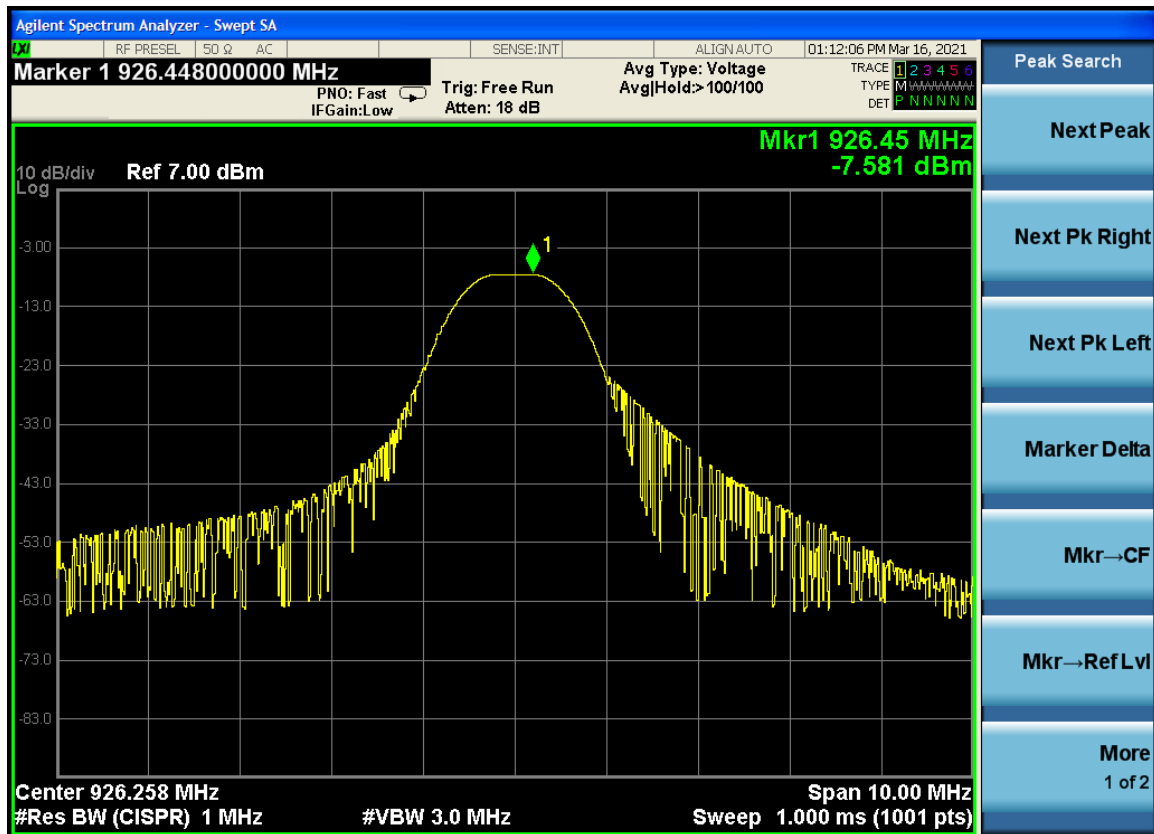


Figure 7.3.3 Peak output power. Operation on Top channel

Section 8 Power Spectral Density

8.1 Test Specification

FCC Rule Part	47CFR 15.247 (e)
ISED Regulation	ISED RSS-247 § 5.2
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
902 MHz to 928 MHz	<8dBm in any 3kHz band during any time interval of complete transmission

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 11.10.2

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 Date of Test16th March 2021**8.2.2 Test Area**

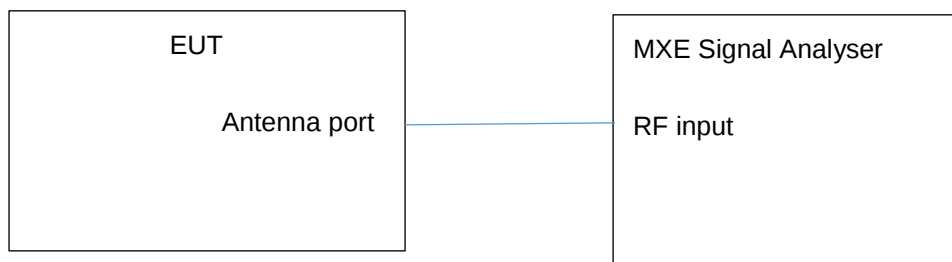
LAB 7

8.2.3 Tested by

M Render

8.2.4 Test Setup

The antenna port was connected directly to the signal analyser.

**8.3 Test Results**

Channel (MHz)	Modulation scheme	Power in 3kHz RBW (dBm)	Limit (dBm)	Figure	Result
903.2	WB-DSSS	-15.408	8.0	8.3.1	Pass
914.4	WB-DSSS	-15.054	8.0	8.3.2	Pass
926.3	WB-DSSS	-16.490	8.0	8.3.3	Pass

Peak Spectral Density Measurements



Figure 8.3.1 Power spectral density. Operation on Bottom channel



Figure 8.3.2 Power spectral density. Operation on Middle channel



Figure 8.3.3 Power spectral density. Operation on Top channel

Section 9 Band Edge Compliance

9.1 Test Specification

FCC Rule Part	47CFR 15.247(d)
ISED Regulation	ISED RSS-247 § 3.3 and 5.5
Standard	ANSI C63.10:2013

No restricted bands as specified by 47CFR 15.205 and RSS Gen 8.10 are adjacent to the band edges of the 902 – 928MHz band.

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
902 MHz to 928 MHz	Measured signal at the band edge must 20 dB below the carrier 47CFR15.247 (d)

Spectrum analyser settings as specified by ANSI C63.10-2013 Clause 6.10.5 “Restricted band-edge measurements”

Receiver Parameters	Setting
Detector Function	Peak
Span	As necessary
Resolution Bandwidth	120 kHz
Video Bandwidth	3 x RBW
Sweep rate	Auto couple
Trace mode	Max hold

9.2.1 Date of Test

20th May 2021

9.2.2 Test Area

LAB 1 (SAC)

9.2.3 Tested by

M Render

9.2.4 Test Setup

The test setup was identical to radiated emissions testing 30MHz-1GHz (section 5.3.5).

9.3 Test Results

Results are presented in two formats:

Tabular results of measurements at the band edges. Manual measurements were performed to measure the maximum value of signal at the band edge. The tabular data includes the following:

1. Polarity of the measurement antenna
2. Frequency at the band edge
3. Amplitude of signal at the input of the test receiver
4. Pre-amplifier gain
5. Cable loss
6. Antenna factor
7. Resultant Electric field strength = 3-4+5+6
8. The measured carrier Electric field strength
9. The band edge limit
10. The margin of result

Spectrum analyser screen displays are also included. Please note that the screen displays do not include losses or antenna factor.

Tabular Data

The following radiated measurements were made at the band edges:

Upper band edge

Polarity	Frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF (dB/m)	E (dBuV/m)	Carrier E (dBuV/m)*	Limit (dBuV/m)	Margin (dB)
H	928.0	8.80	25.72	3.06	26.40	12.54	72.22	52.22	-39.68
V	928.0	12.01	25.72	3.06	26.40	15.75	79.04	59.04	-43.29

Operation on Top Channel, ANT-868-CW-RAH Antenna - Band edge measurements

Polarity	Frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF (dB/m)	E (dBuV/m)	Carrier E (dBuV/m)*	Limit (dBuV/m)	Margin (dB)
H	928.0	9.06	25.72	3.06	26.40	12.80	68.87	48.87	-36.07
V	928.0	13.14	25.72	3.06	26.40	16.88	79.71	59.71	-42.83

Operation on Top Channel, WMO86916 Antenna - Band edge measurements

Lower band edge

Polarity	Frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF (dB/m)	E (dBuV/m)	Carrier E (dBuV/m)*	Limit (dBuV/m)	Margin (dB)
H	902.0	16.21	25.60	3.01	26.58	20.20	73.87	53.87	-33.67
V	902.0	23.23	25.60	3.01	26.58	27.22	79.75	59.75	-32.53

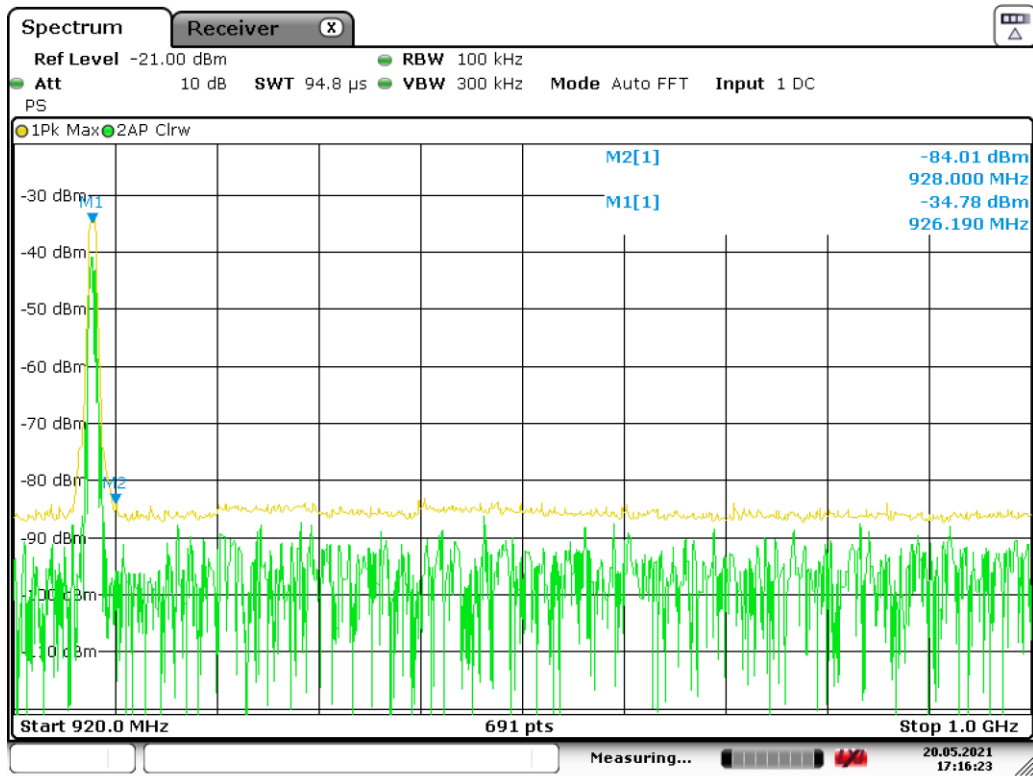
Operation on Bottom Channel, ANT-868-CW-RAH Antenna - Band edge measurements

Polarity	Frequency (MHz)	Amplitude (dBuV)	Preamp (dB)	Cable loss (dB)	AF (dB/m)	E (dBuV/m)	Carrier E (dBuV/m)*	Limit (dBuV/m)	Margin (dB)
H	928.0	12.76	25.60	3.01	26.58	16.75	74.25	54.25	-37.50
V	928.0	25.67	25.60	3.01	26.58	29.66	82.65	62.65	-32.99

Operation on Bottom Channel, WMO86916 Antenna - Band edge measurements

* The carrier field strength was measured to determine the band edge limit (20dBc) as per clause 15.247(d).

Spectrum analyser displays



Date: 20.MAY.2021 17:16:24

Band Edge Measurement – ANT-868-CW-RAH Antenna - upper band edge - horizontal polarity

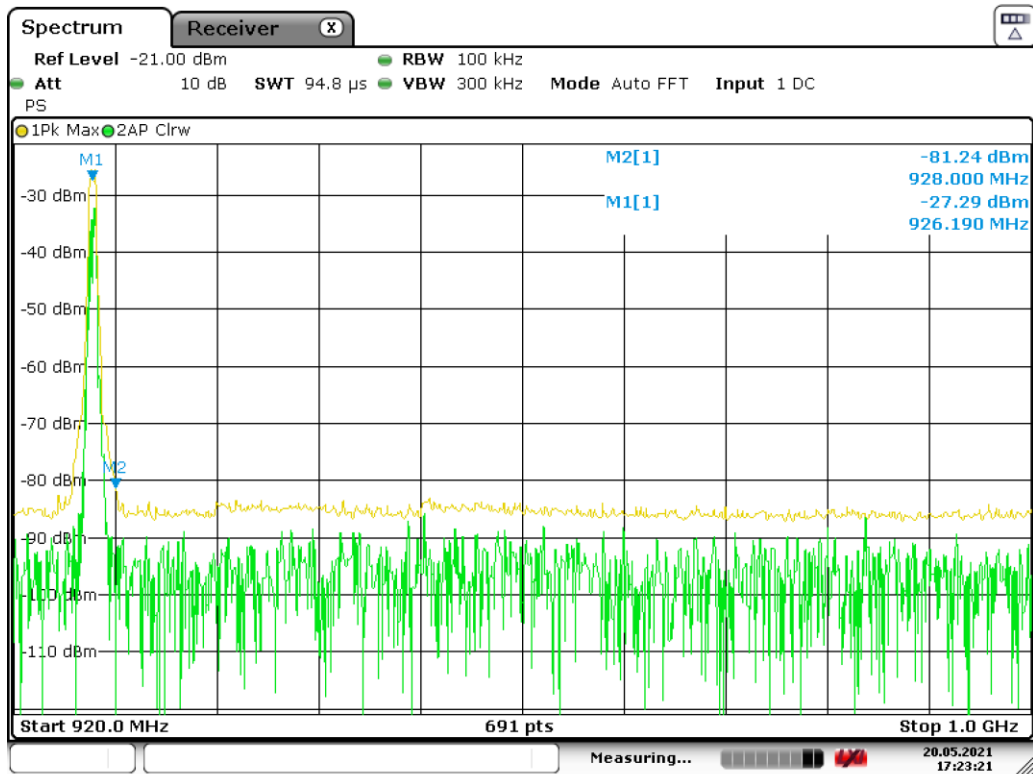


Date: 20.MAY.2021 17:15:04

Band Edge Measurement – ANT-868-CW-RAH Antenna - upper band edge - vertical polarity

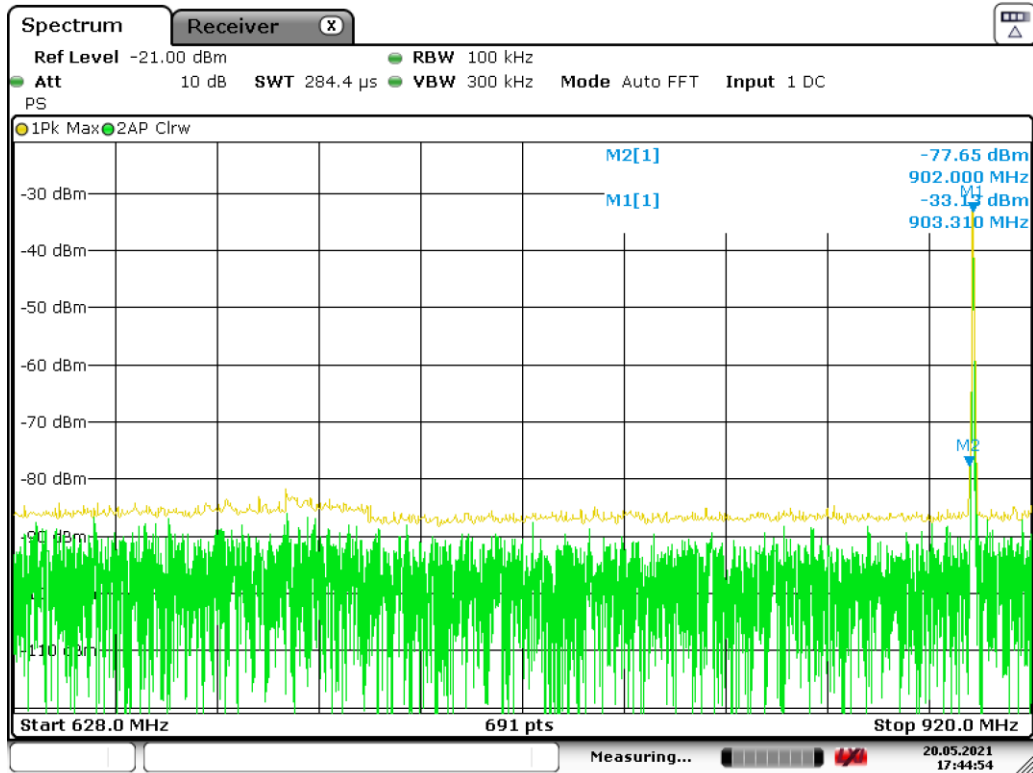


Date: 20.MAY.2021 17:21:32

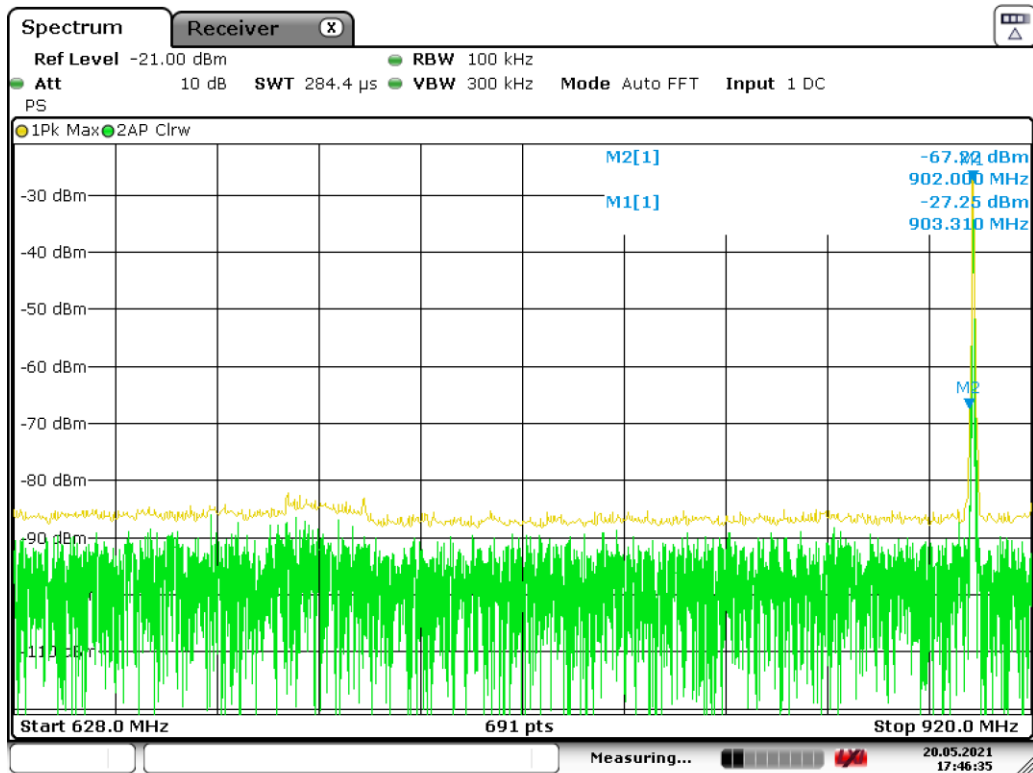
Band Edge Measurement – WMO86916 Antenna - upper band edge - horizontal polarity

Date: 20.MAY.2021 17:23:21

Band Edge Measurement – WMO86916 Antenna - upper band edge - vertical polarity

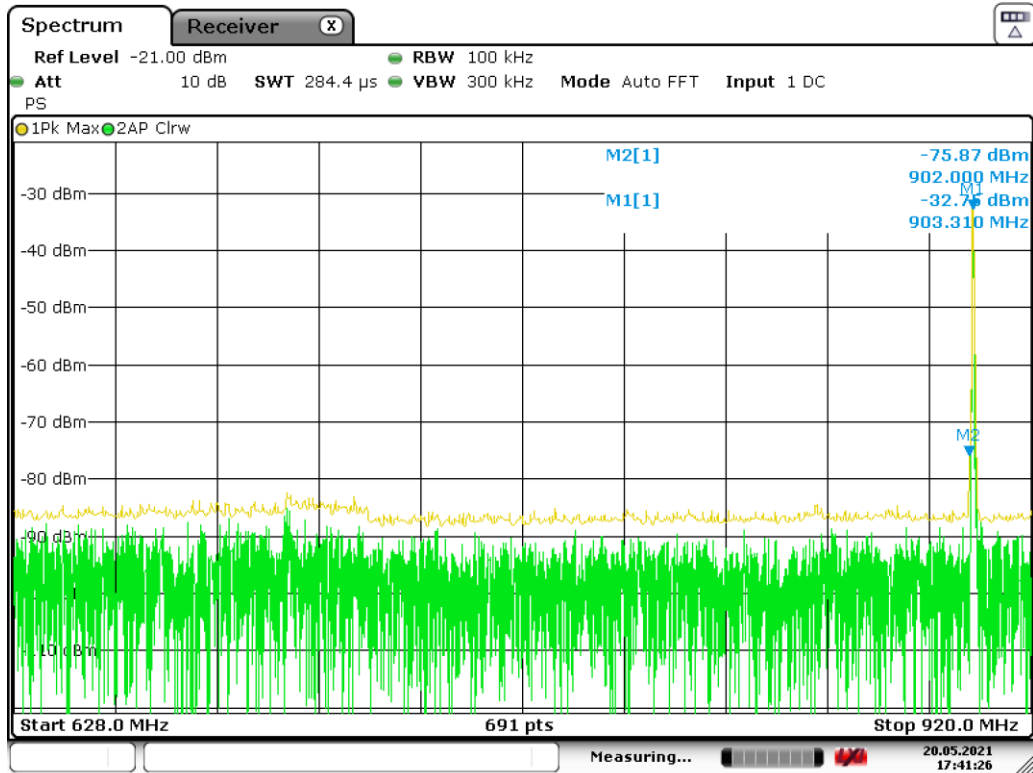


Date: 20.MAY.2021 17:44:55

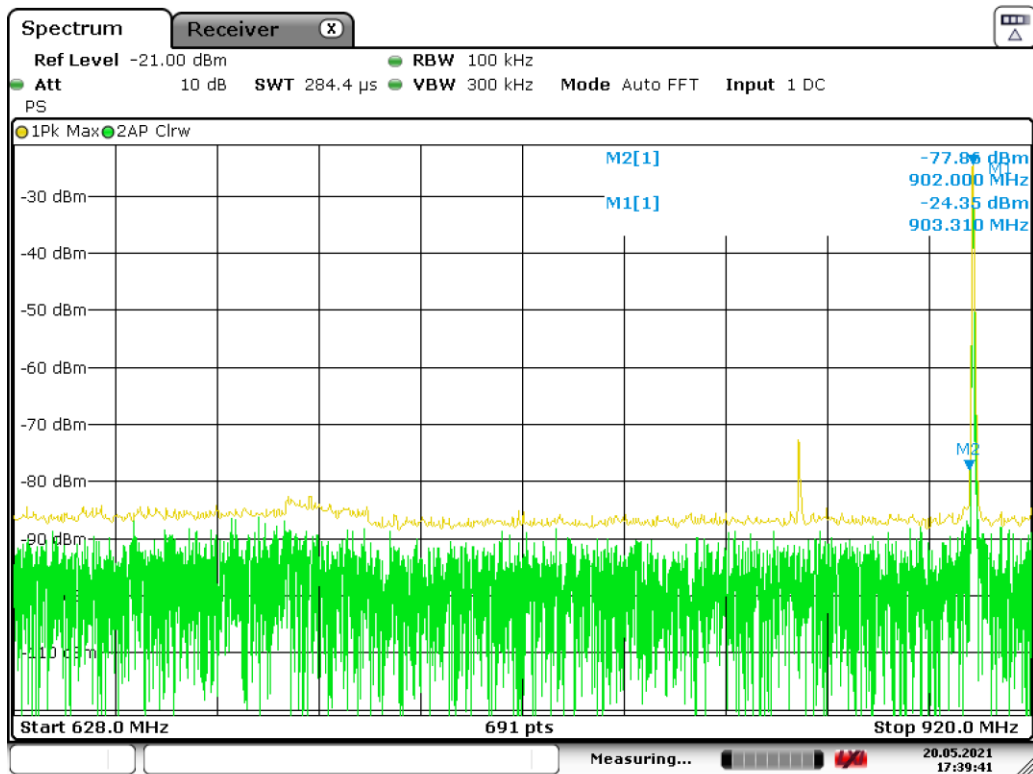
Band Edge Measurement – ANT-868-CW-RAH Antenna - lower band edge - horizontal polarity

Date: 20.MAY.2021 17:46:36

Band Edge Measurement – ANT-868-CW-RAH Antenna - lower band edge - vertical polarity



Date: 20.MAY.2021 17:41:27

Band Edge Measurement – WMO86916 Antenna - lower band edge - horizontal polarity

Date: 20.MAY.2021 17:39:41

Band Edge Measurement – WMO86916 Antenna - lower band edge - vertical polarity

Section 10 AC Mains Conducted Emissions

10.1 Test Specification

FCC Rule Part	FCC § 15.207
ISED Regulation	ISED RSS-247 § 3.1
Standard	ANSI C63.10:2013
Measurement Uncertainty	The reported uncertainty of measurement $y \pm U$, where expanded 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 $\pm 3.45\text{dB}$

10.2 Power Line Emission Limits

Frequency (MHz)	Class A (dB μ V)		Class B (dB μ V)	
	Quasi Peak	Average	Quasi Peak	Average
0.15 – 0.5	79.0	66.0	66 – 56*	56 – 46*
0.5 – 5.0	73.0	60.0	56.0	46.0
5.0 - 30	73.0	60.0	60.0	50.0

Note: * The limit decreases linearly with the logarithm of the frequency in the range

10.3 Receiver Settings

Receiver Parameters	Setting
Detector Function	Quasi Peak and Average
Start Frequency	150kHz
Stop Frequency	30MHz
Resolution Bandwidth	10kHz
Video Bandwidth	Auto

10.4 Procedure and Test Software Version

Eurofins York test procedure	CEP19 Issue 5
Test software	RadiMation Version 2016.1.6

10.4.1 Date of Test21st May 2021**10.4.2 Test Area**

LAB 2

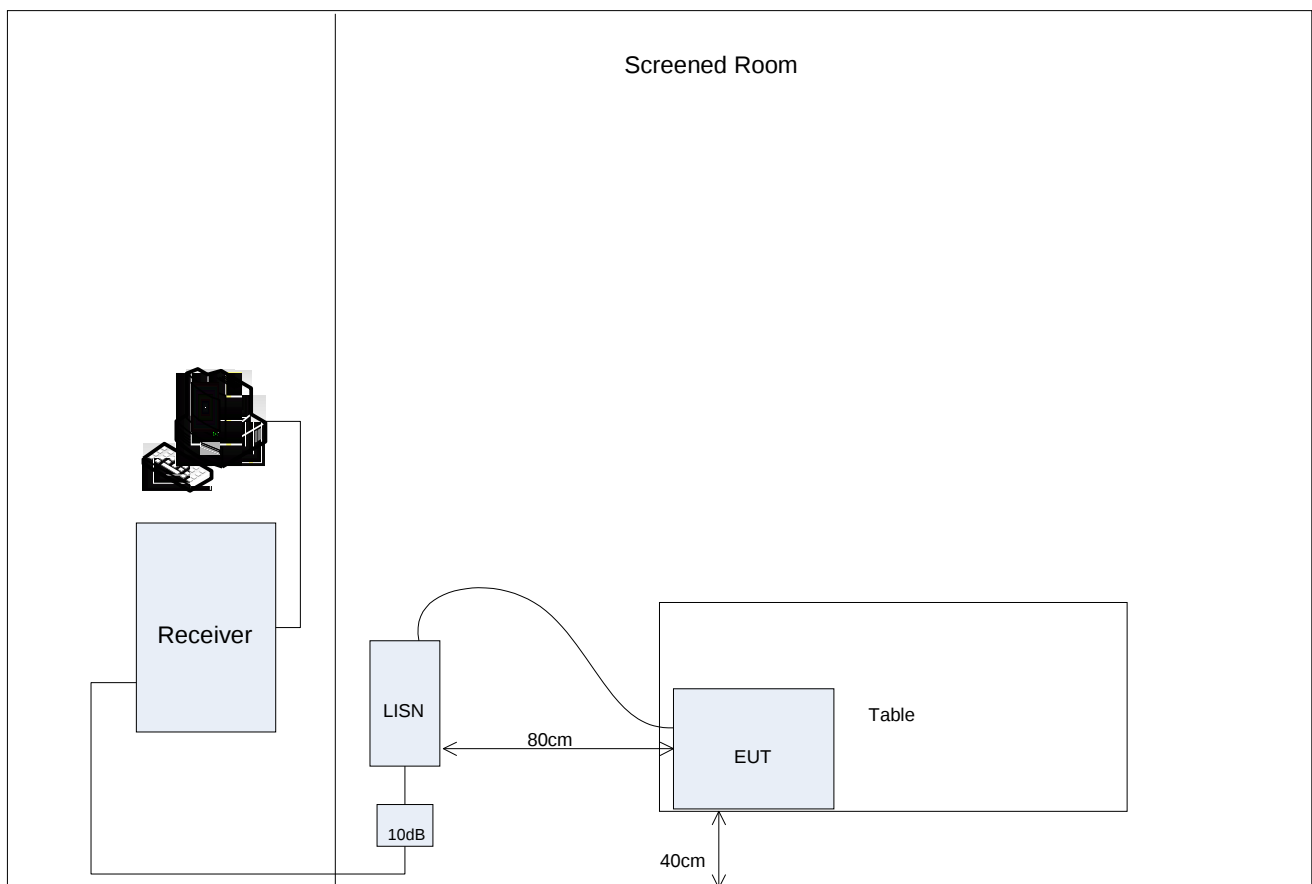
10.4.3 Tested by

M Render

10.4.4 Test Setup

This test was applied to the EUT's Live and Neutral lines. The EUT was configured in the screened room on an 80cm high table was positioned 40cm from the room wall.

A calibrated mains extension lead was used to ensure a known impedance was presented to the EUT. The EUT was then powered from the mains supply via a Line Impedance Stabilisation Network (LISN).

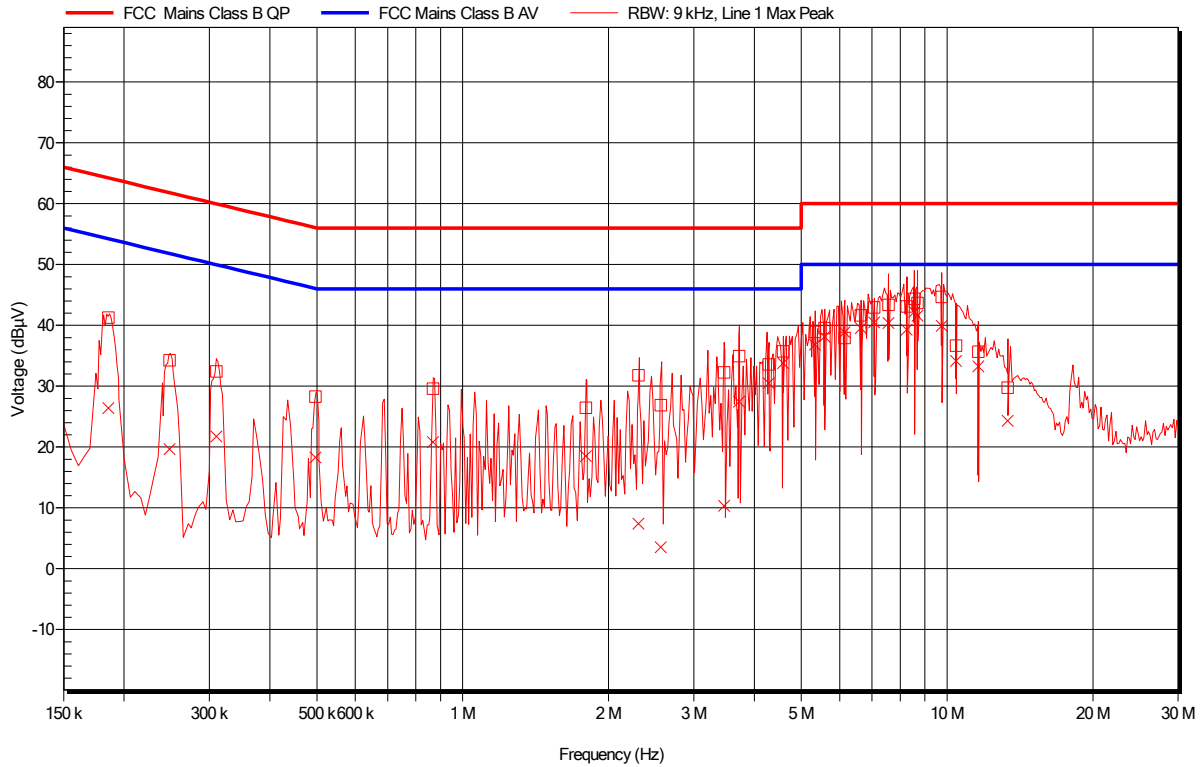


10.5 Test Results

This section contains graphical and tabulated data. The following data is presented

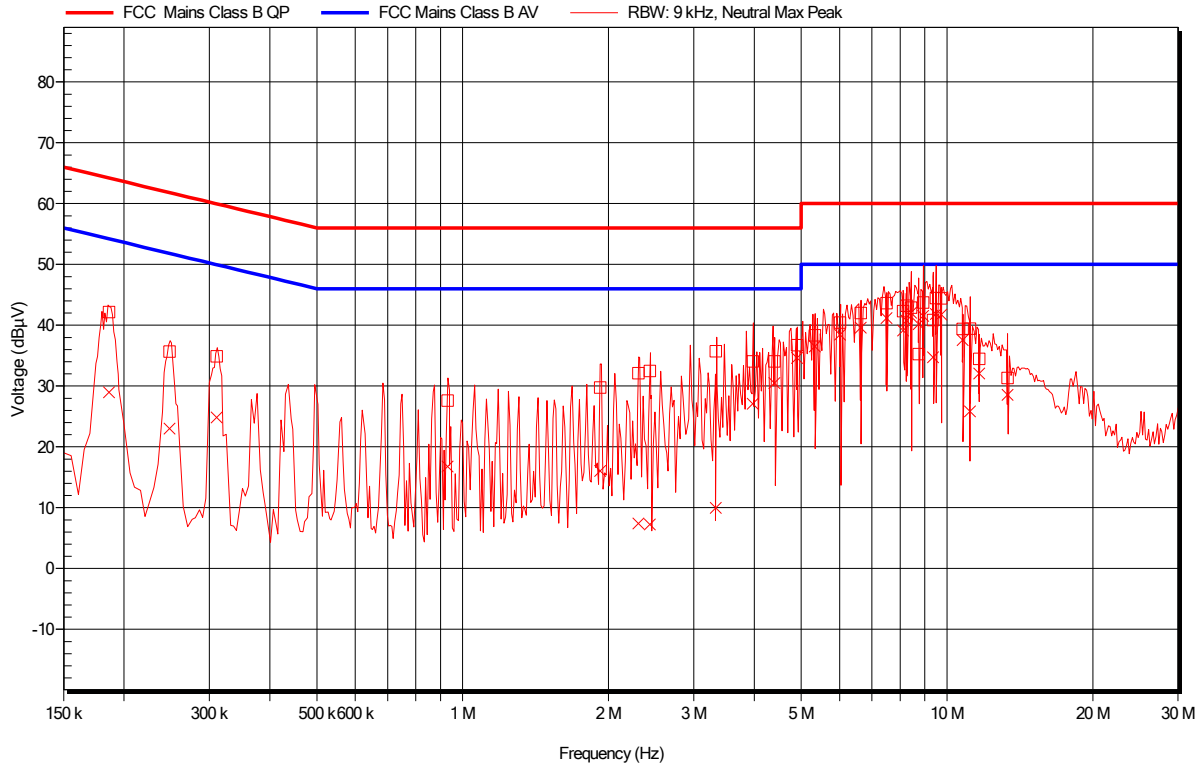
Antenna	Channel	Conductor	Result summary
ANT-868-CW-RAH	Bottom	Live	Pass
ANT-868-CW-RAH	Bottom	Neutral	Pass
ANT-868-CW-RAH	Middle	Live	Pass
ANT-868-CW-RAH	Middle	Neutral	Pass
ANT-868-CW-RAH	Top	Live	Pass
ANT-868-CW-RAH	Top	Neutral	Pass
WMO86916	Bottom	Live	Pass
WMO86916	Bottom	Neutral	Pass
WMO86916	Middle	Live	Pass
WMO86916	Middle	Neutral	Pass
WMO86916	Top	Live	Pass
WMO86916	Top	Neutral	Pass

The equipment under test was pre-scanned using peak detection when operating on all three channels for both antenna options. Final measurements were performed with the equipment under all the same modes.



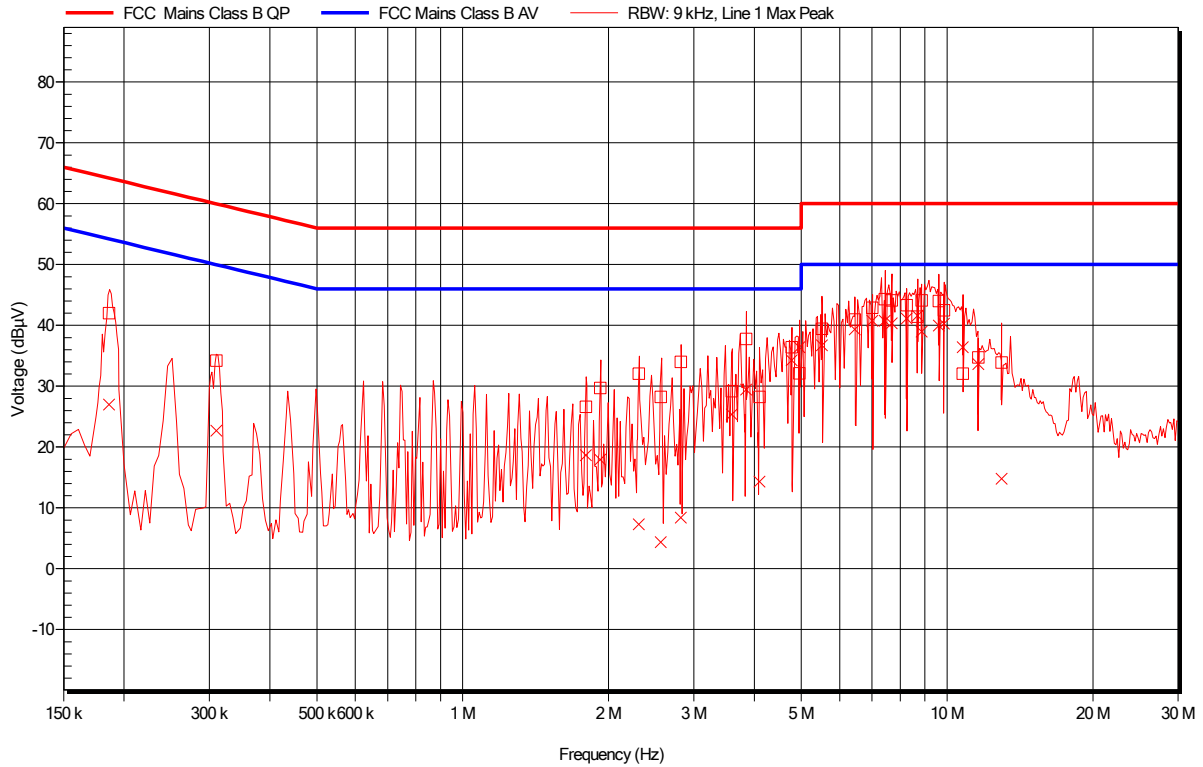
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Bottom Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	26.4	54.2	-27.81	Pass	41.3	64.2	-22.97	Pass
0.248	19.6	51.8	-32.18	Pass	34.2	61.8	-27.58	Pass
0.310	21.8	50.0	-28.21	Pass	32.5	60.0	-27.52	Pass
0.497	18.3	46.1	-27.77	Pass	28.3	56.1	-27.76	Pass
0.869	20.8	46.0	-25.18	Pass	29.6	56.0	-26.38	Pass
1.797	18.5	46.0	-27.48	Pass	26.5	56.0	-29.53	Pass
2.306	7.4	46.0	-38.58	Pass	31.8	56.0	-24.20	Pass
2.562	3.6	46.0	-42.45	Pass	26.9	56.0	-29.13	Pass
3.463	10.3	46.0	-35.67	Pass	32.3	56.0	-23.70	Pass
3.72	27.5	46.0	-18.55	Pass	34.9	56.0	-21.08	Pass
4.281	30.5	46.0	-15.49	Pass	33.6	56.0	-22.43	Pass
4.588	33.8	46.0	-12.19	Pass	35.7	56.0	-20.3	Pass
5.335	36.8	50.0	-13.17	Pass	38.9	60.0	-21.06	Pass
5.58	38.1	50.0	-11.86	Pass	39.6	60.0	-20.45	Pass
6.141	38.9	50.0	-11.14	Pass	37.9	60.0	-22.06	Pass
6.637	39.5	50.0	-10.45	Pass	41.6	60.0	-18.36	Pass
7.069	40.5	50.0	-9.53	Pass	42.9	60.0	-17.07	Pass
7.567	40.4	50.0	-9.62	Pass	43.4	60.0	-16.62	Pass
8.557	42.2	50.0	-7.77	Pass	44.4	60.0	-15.64	Pass
8.683	41.6	50.0	-8.42	Pass	43.7	60.0	-16.31	Pass
9.741	39.9	50.0	-10.06	Pass	44.7	60.0	-15.33	Pass
10.428	34.2	50.0	-15.83	Pass	36.7	60.0	-23.33	Pass
11.598	33.3	50.0	-16.73	Pass	35.7	60.0	-24.34	Pass
13.337	24.3	50.0	-25.70	Pass	29.7	60.0	-30.26	Pass



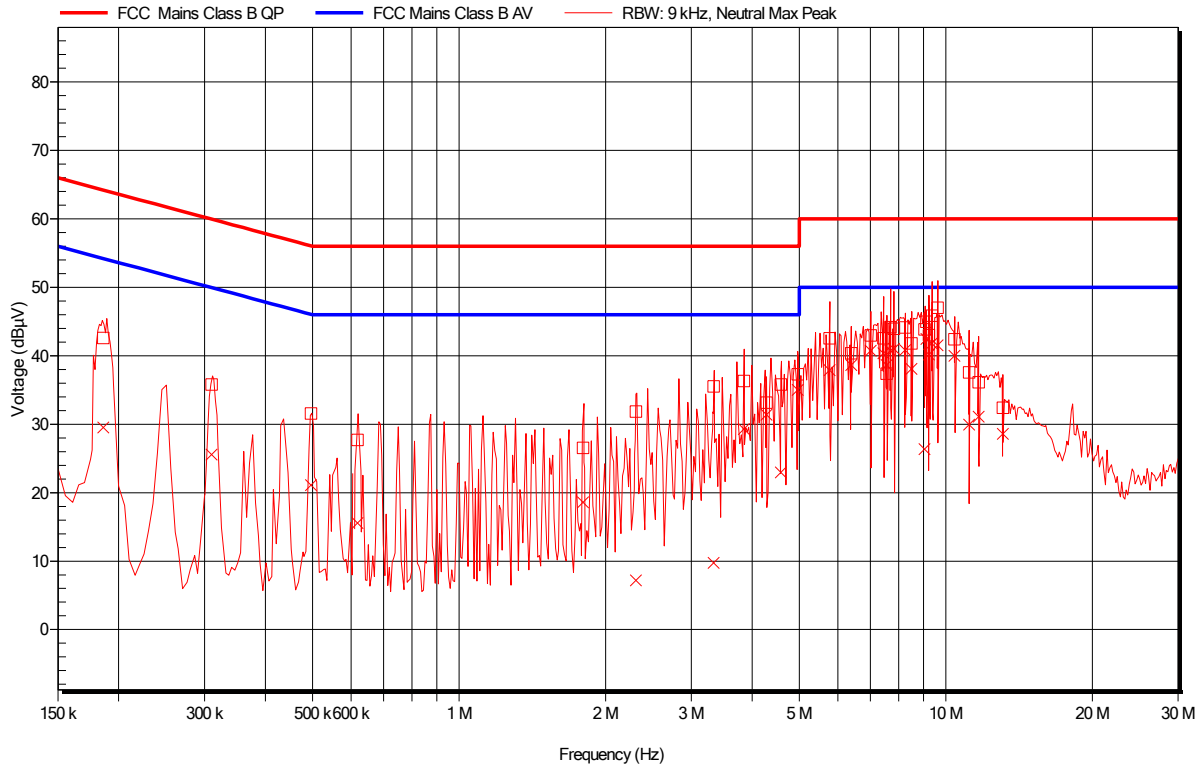
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Bottom Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	29.0	54.2	-25.23	Pass	42.1	64.2	-22.06	Pass
0.248	23.0	51.8	-28.84	Pass	35.7	61.8	-26.15	Pass
0.311	24.9	50	-25.10	Pass	34.9	60	-25.08	Pass
0.932	16.8	46	-29.25	Pass	27.6	56	-28.37	Pass
1.923	16.0	46	-29.97	Pass	29.7	56	-26.25	Pass
2.307	7.4	46	-38.59	Pass	32.1	56	-23.90	Pass
2.435	7.3	46	-38.75	Pass	32.5	56	-23.54	Pass
3.333	10.0	46	-36.03	Pass	35.7	56	-20.29	Pass
3.972	27.1	46	-18.91	Pass	34.0	56	-21.96	Pass
4.398	30.5	46	-15.50	Pass	34.1	56	-21.95	Pass
4.899	34.6	46	-11.40	Pass	36.7	56	-19.26	Pass
5.332	36.5	50	-13.48	Pass	38.4	60	-21.65	Pass
6.016	38.4	50	-11.55	Pass	40.4	60	-19.55	Pass
6.633	39.6	50	-10.42	Pass	42.0	60	-18.00	Pass
7.499	41.2	50	-8.83	Pass	43.7	60	-16.35	Pass
8.733	40.2	50	-9.83	Pass	35.3	60	-24.73	Pass
8.931	41.5	50	-8.48	Pass	43.7	60	-16.27	Pass
9.356	34.7	50	-15.28	Pass	40.9	60	-19.15	Pass
9.486	41.8	50	-8.16	Pass	44.5	60	-15.54	Pass
9.733	41.8	50	-8.23	Pass	44.4	60	-15.59	Pass
10.772	37.5	50	-12.46	Pass	39.4	60	-20.59	Pass
11.151	25.8	50	-24.17	Pass	39.5	60	-20.55	Pass
11.65	32.0	50	-17.95	Pass	34.5	60	-25.52	Pass
13.331	28.6	50	-21.44	Pass	31.3	60	-28.68	Pass



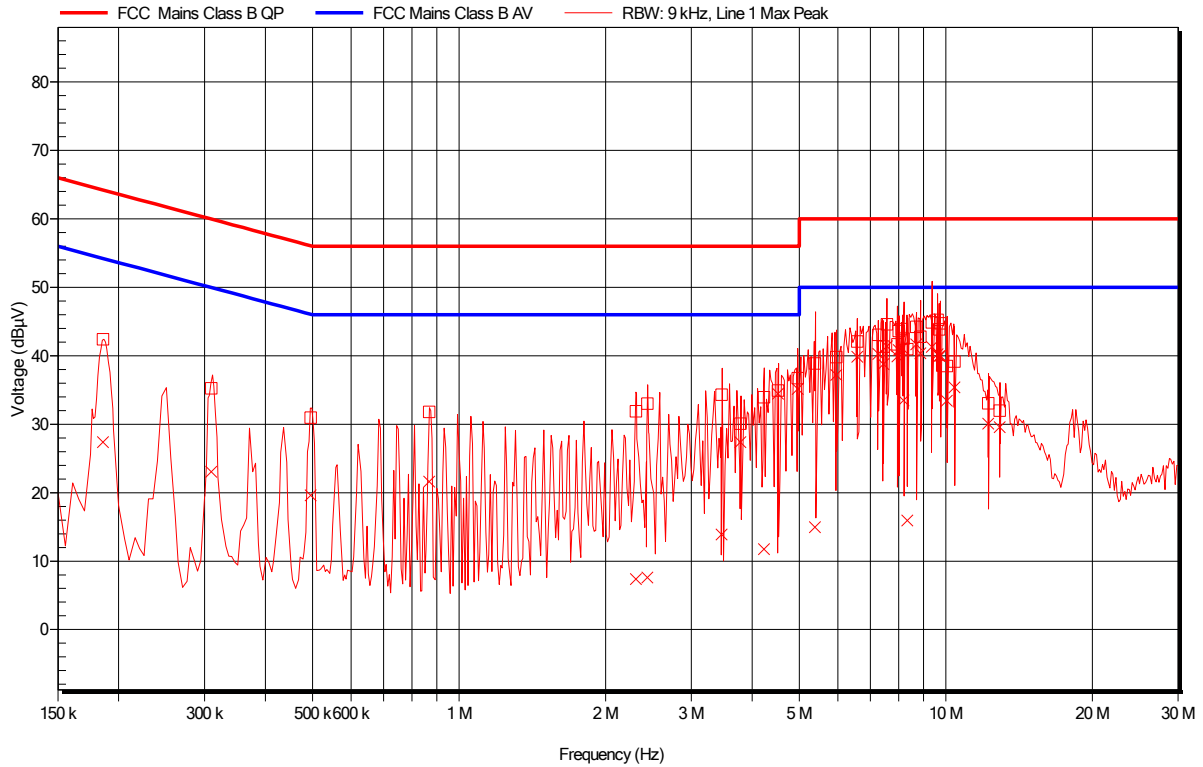
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Middle Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	27.0	54.2	-27.22	Pass	42.0	64.2	-22.22	Pass
0.310	22.7	50	-27.26	Pass	34.2	60	-25.78	Pass
1.796	18.6	46	-27.35	Pass	26.6	56	-29.37	Pass
1.922	17.9	46	-28.09	Pass	29.7	56	-26.28	Pass
2.308	7.3	46	-38.71	Pass	32.0	56	-23.96	Pass
2.563	4.4	46	-41.65	Pass	28.2	56	-27.77	Pass
2.819	8.4	46	-37.60	Pass	34.0	56	-21.98	Pass
3.593	25.4	46	-20.63	Pass	29.2	56	-26.82	Pass
3.845	29.4	46	-16.56	Pass	37.8	56	-18.21	Pass
4.100	14.3	46	-31.69	Pass	28.2	56	-27.77	Pass
4.773	34.3	46	-11.74	Pass	36.4	56	-19.60	Pass
4.955	36.4	46	-9.59	Pass	32.1	56	-23.90	Pass
5.515	36.7	50	-13.30	Pass	39.4	60	-20.55	Pass
6.449	39.4	50	-10.65	Pass	41.0	60	-19.03	Pass
7.005	40.7	50	-9.27	Pass	42.9	60	-17.10	Pass
7.437	40.8	50	-9.24	Pass	44.3	60	-15.68	Pass
7.689	40.3	50	-9.68	Pass	44.1	60	-15.90	Pass
8.247	41.1	50	-8.89	Pass	43.3	60	-16.66	Pass
8.856	39.0	50	-11.03	Pass	44.1	60	-15.90	Pass
9.612	40.0	50	-10.02	Pass	44.0	60	-16.02	Pass
9.855	40.3	50	-9.73	Pass	42.5	60	-17.51	Pass
10.776	36.4	50	-13.59	Pass	32.1	60	-27.92	Pass
11.592	33.6	50	-16.37	Pass	34.7	60	-25.27	Pass
12.948	14.8	50	-35.22	Pass	33.9	60	-26.08	Pass



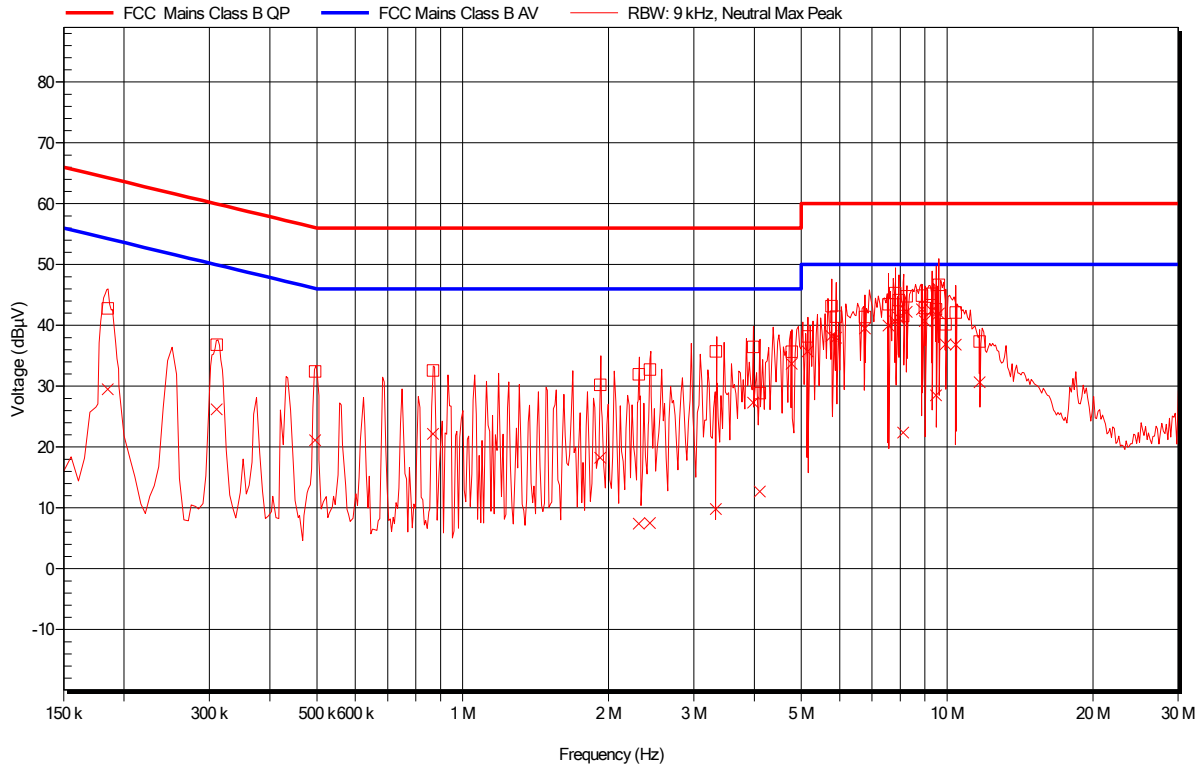
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Middle Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	29.5	54.2	-24.70	Pass	42.6	64.2	-21.62	Pass
0.311	25.6	50	-24.37	Pass	35.8	60	-24.14	Pass
0.497	21.1	46.1	-24.98	Pass	31.6	56.1	-24.49	Pass
0.619	15.6	46	-30.42	Pass	27.7	56	-28.28	Pass
1.798	18.6	46	-27.41	Pass	26.5	56	-29.47	Pass
2.308	7.2	46	-38.81	Pass	31.8	56	-24.16	Pass
3.334	9.8	46	-36.25	Pass	35.5	56	-20.46	Pass
3.843	29.3	46	-16.69	Pass	36.3	56	-19.68	Pass
4.28	31.4	46	-14.62	Pass	33.2	56	-22.83	Pass
4.582	23.0	46	-23.04	Pass	35.8	56	-20.17	Pass
4.959	35.0	46	-11.00	Pass	37.3	56	-18.70	Pass
5.769	37.9	50	-12.10	Pass	42.6	60	-17.45	Pass
6.388	38.7	50	-11.34	Pass	40.4	60	-19.62	Pass
7.006	40.7	50	-9.27	Pass	43.0	60	-17.01	Pass
7.69	40.7	50	-9.27	Pass	44.2	60	-15.83	Pass
7.817	41.0	50	-9.00	Pass	44.0	60	-16.04	Pass
8.489	38.1	50	-11.92	Pass	41.8	60	-18.17	Pass
9.043	26.4	50	-23.64	Pass	43.9	60	-16.14	Pass
9.361	41.8	50	-8.17	Pass	45.8	60	-14.16	Pass
9.616	41.5	50	-8.47	Pass	47.0	60	-13.00	Pass
10.415	40.0	50	-10.02	Pass	42.4	60	-17.57	Pass
11.155	29.9	50	-20.05	Pass	37.6	60	-22.42	Pass
11.666	31.1	50	-18.89	Pass	36.2	60	-23.85	Pass
13.082	28.6	50	-21.39	Pass	32.4	60	-27.58	Pass



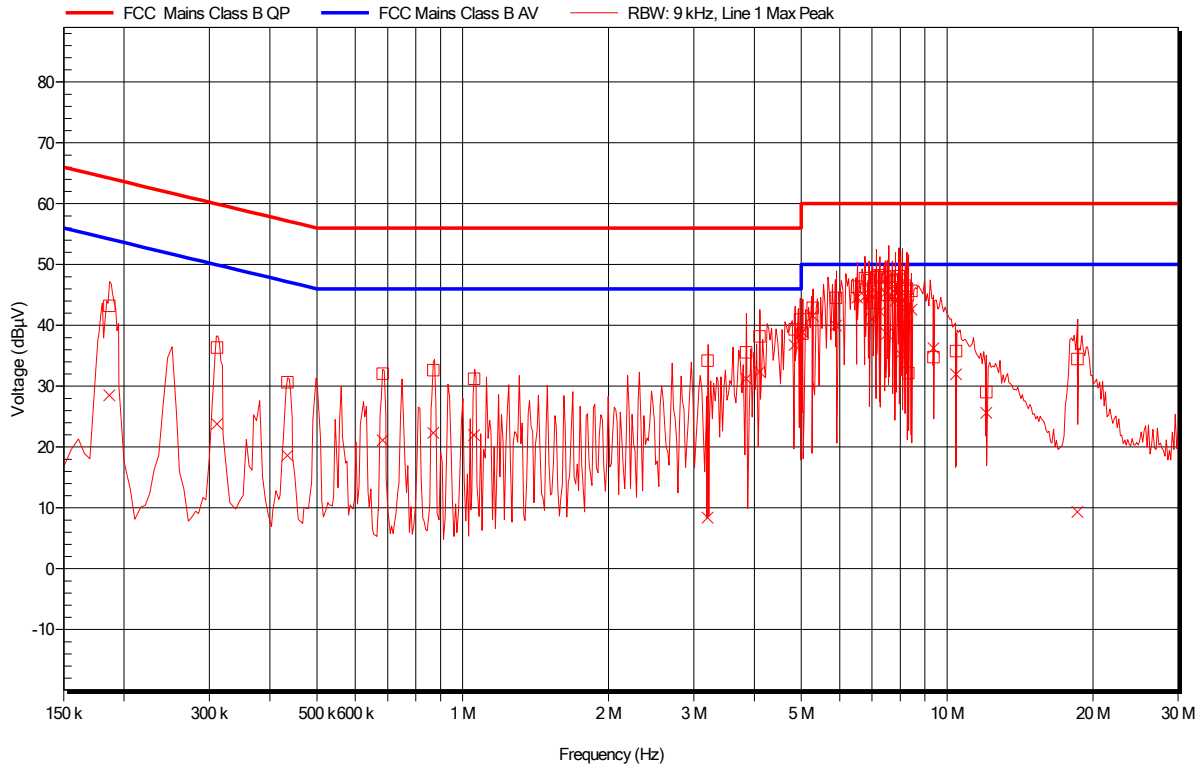
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Top Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	27.4	54.2	-26.84	Pass	42.4	64.2	-21.83	Pass
0.310	23.1	50	-26.92	Pass	35.3	60	-24.71	Pass
0.496	19.6	46.1	-26.45	Pass	31.0	56.1	-25.09	Pass
0.869	21.6	46	-24.38	Pass	31.8	56	-24.20	Pass
2.307	7.4	46	-38.61	Pass	31.9	56	-24.10	Pass
2.436	7.6	46	-38.40	Pass	33.0	56	-23.00	Pass
3.461	13.9	46	-32.09	Pass	34.3	56	-21.69	Pass
3.782	27.4	46	-18.6	Pass	30.1	56	-25.93	Pass
4.229	11.7	46	-34.27	Pass	33.9	56	-22.05	Pass
4.522	34.5	46	-11.54	Pass	34.9	56	-21.08	Pass
4.961	35.1	46	-10.85	Pass	36.7	56	-19.25	Pass
5.384	15.0	50	-35.04	Pass	38.9	60	-21.13	Pass
5.951	37.2	50	-12.78	Pass	39.8	60	-20.17	Pass
6.574	39.9	50	-10.12	Pass	42.1	60	-17.92	Pass
7.258	40.3	50	-9.73	Pass	43.1	60	-16.94	Pass
7.998	40.8	50	-9.15	Pass	43.6	60	-16.40	Pass
8.125	41.2	50	-8.83	Pass	43.9	60	-16.11	Pass
8.865	40.4	50	-9.65	Pass	42.8	60	-17.19	Pass
9.362	41.3	50	-8.71	Pass	44.9	60	-15.11	Pass
9.741	40.0	50	-9.98	Pass	44.7	60	-15.27	Pass
10.041	33.4	50	-16.56	Pass	38.5	60	-21.48	Pass
10.415	35.4	50	-14.59	Pass	39.2	60	-20.83	Pass
12.214	30.1	50	-19.90	Pass	33.1	60	-26.95	Pass
12.900	29.6	50	-20.41	Pass	32.0	60	-28.02	Pass



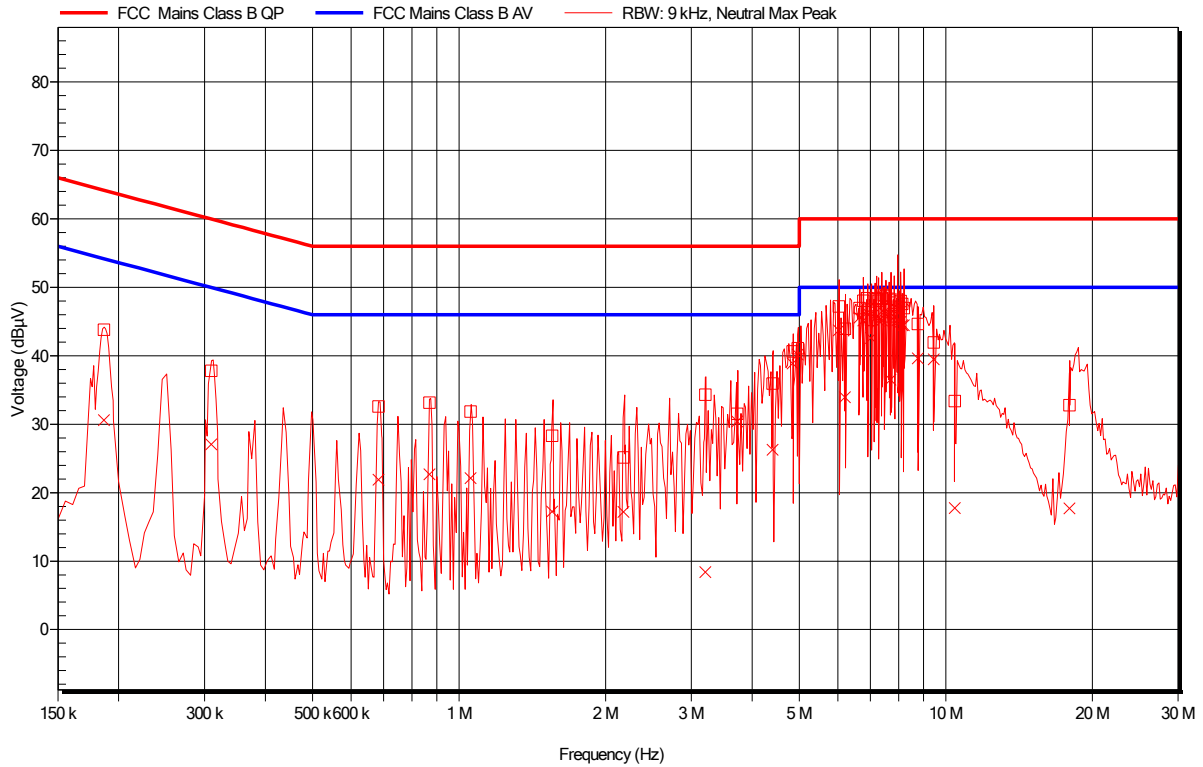
AC mains conducted emissions. ANT-868-CW-RAH Antenna - Operation on Top Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.185	29.5	54.3	-24.76	Pass	42.8	64.3	-21.44	Pass
0.311	26.2	50	-23.78	Pass	36.8	60	-23.15	Pass
0.499	21.1	46.1	-24.93	Pass	32.4	56.1	-23.66	Pass
0.869	22.1	46	-23.86	Pass	32.6	56	-23.41	Pass
1.923	18.3	46	-27.74	Pass	30.2	56	-25.79	Pass
2.307	7.4	46	-38.57	Pass	31.9	56	-24.05	Pass
2.435	7.5	46	-38.49	Pass	32.7	56	-23.27	Pass
3.333	9.8	46	-36.18	Pass	35.7	56	-20.30	Pass
3.974	27.3	46	-18.69	Pass	36.5	56	-19.52	Pass
4.104	12.7	46	-33.31	Pass	28.9	56	-27.13	Pass
4.777	33.7	46	-12.33	Pass	35.7	56	-20.32	Pass
5.149	35.7	50	-14.29	Pass	38.2	60	-21.81	Pass
5.896	38.0	50	-12.01	Pass	41.4	60	-18.58	Pass
6.763	39.5	50	-10.52	Pass	41.4	60	-18.59	Pass
7.565	40.0	50	-10.04	Pass	43.5	60	-16.52	Pass
8.25	42.2	50	-7.77	Pass	44.8	60	-15.22	Pass
8.871	42.6	50	-7.36	Pass	44.9	60	-15.13	Pass
8.999	40.7	50	-9.28	Pass	42.9	60	-17.14	Pass
9.305	42.4	50	-7.59	Pass	45.2	60	-14.79	Pass
9.483	28.5	50	-21.50	Pass	42.6	60	-17.36	Pass
9.616	42.0	50	-8.04	Pass	46.7	60	-13.35	Pass
9.921	36.9	50	-13.1	Pass	40.2	60	-19.85	Pass
10.421	36.8	50	-13.17	Pass	42.1	60	-17.91	Pass
11.667	30.6	50	-19.37	Pass	37.4	60	-22.65	Pass



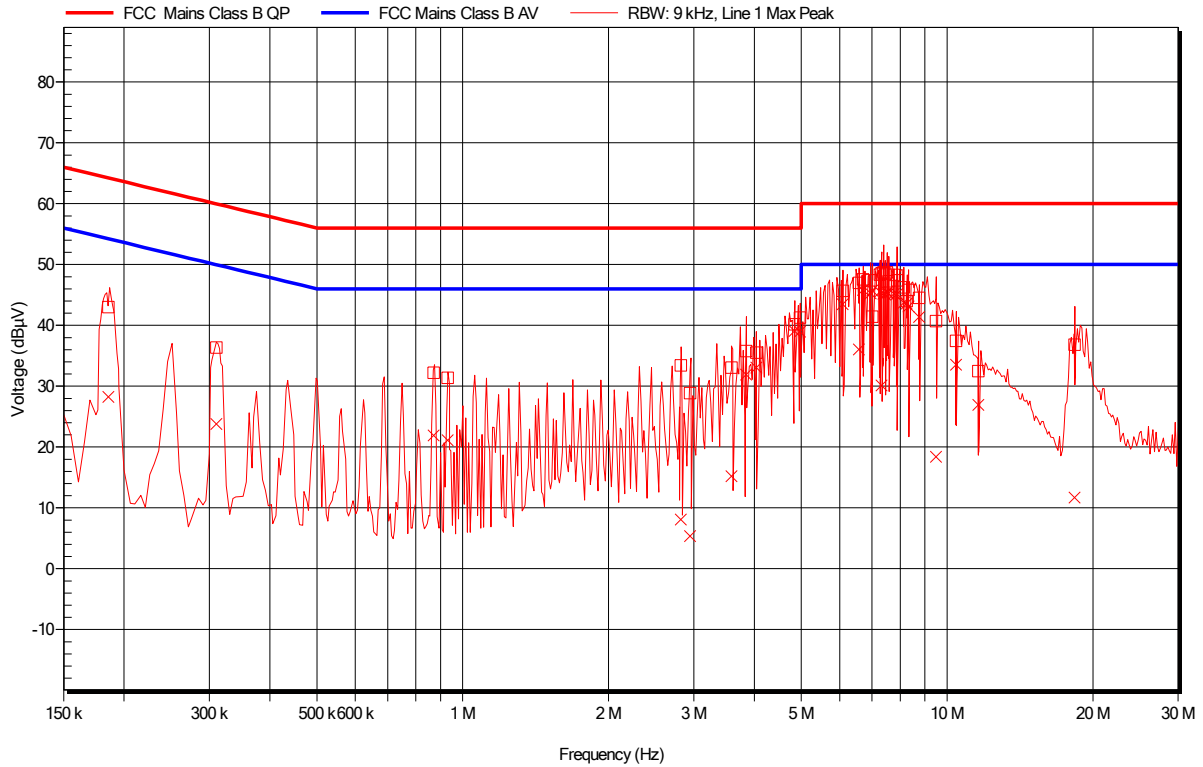
AC mains conducted emissions. WMO86916 Antenna - Operation on Bottom Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.188	27.6	54.1	-26.51	Pass	42.5	64.1	-21.67	Pass
0.249	21.9	51.8	-29.87	Pass	36.3	61.8	-25.54	Pass
0.311	23.8	50	-26.18	Pass	36.0	60	-23.92	Pass
0.496	20.0	46.1	-26.04	Pass	31.7	56.1	-24.35	Pass
0.869	22.1	46	-23.87	Pass	32.2	56	-23.75	Pass
1.054	21.6	46	-24.44	Pass	30.6	56	-25.36	Pass
2.308	7.6	46	-38.36	Pass	31.6	56	-24.37	Pass
3.590	23.7	46	-22.26	Pass	33.3	56	-22.69	Pass
3.910	32.8	46	-13.22	Pass	34.3	56	-21.70	Pass
4.283	34.8	46	-11.22	Pass	37.0	56	-18.96	Pass
4.779	37.4	46	-8.61	Pass	39.7	56	-16.30	Pass
5.400	40.9	50	-9.07	Pass	43.4	60	-16.58	Pass
6.023	43.1	50	-6.92	Pass	46.2	60	-13.83	Pass
6.638	45.0	50	-5.03	Pass	46.8	60	-13.25	Pass
6.946	42.9	50	-7.10	Pass	45.2	60	-14.80	Pass
7.075	45.2	50	-4.82	Pass	47.8	60	-12.21	Pass
7.884	44.2	50	-5.80	Pass	46.6	60	-13.41	Pass
8.008	43.8	50	-6.18	Pass	46.6	60	-13.41	Pass
8.494	40.6	50	-9.36	Pass	35.6	60	-24.45	Pass
9.064	39.3	50	-10.71	Pass	43.7	60	-16.35	Pass
9.680	38.0	50	-12.01	Pass	41.8	60	-18.23	Pass
10.419	34.8	50	-15.20	Pass	32.2	60	-27.78	Pass
11.857	28.3	50	-21.67	Pass	31.5	60	-28.51	Pass
18.335	11.1	50	-38.92	Pass	36.5	60	-23.53	Pass



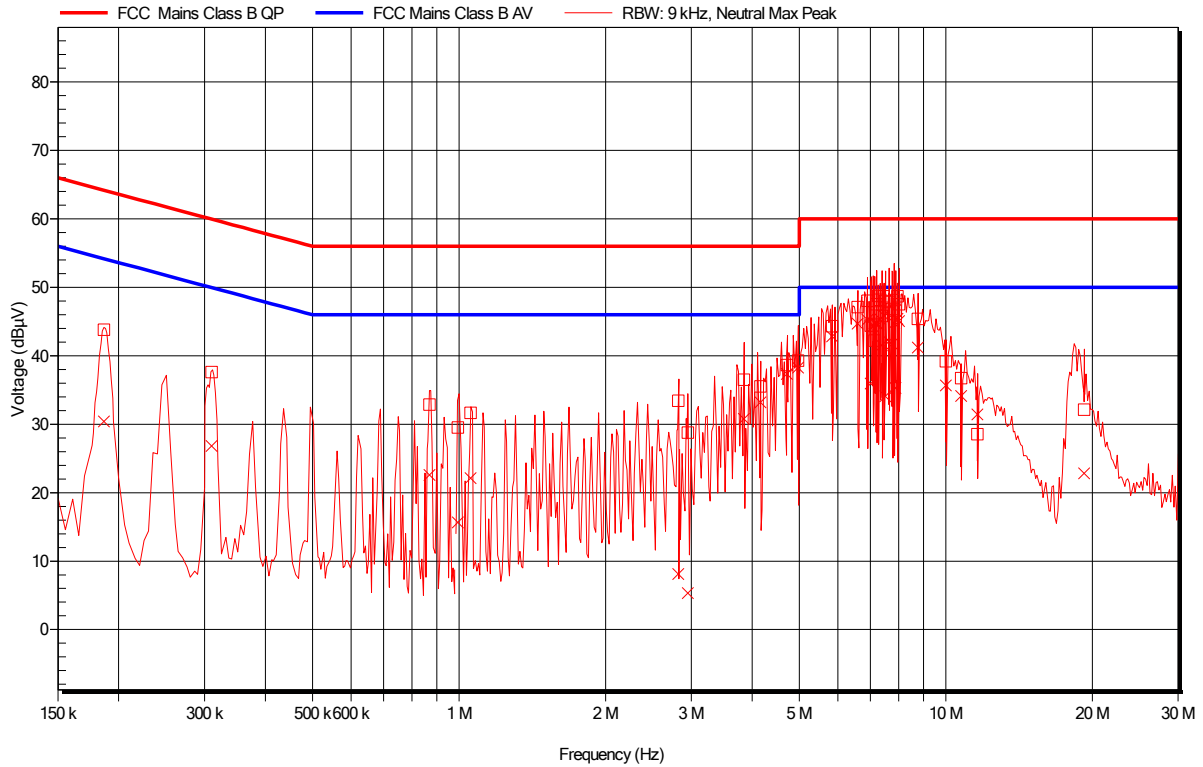
AC mains conducted emissions. WMO86916 Antenna - Operation on Bottom Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.188	29.9	54.1	-24.26	Pass	42.8	64.1	-21.33	Pass
0.311	26.5	50	-23.42	Pass	37.3	60	-22.62	Pass
0.497	22.0	46	-24.05	Pass	32.4	56	-23.65	Pass
0.930	20.8	46	-25.24	Pass	31.6	56	-24.40	Pass
1.181	12.3	46	-33.66	Pass	27.5	56	-28.53	Pass
1.802	19.0	46	-27.03	Pass	26.4	56	-29.61	Pass
3.477	29.0	46	-17.04	Pass	30.1	56	-25.93	Pass
3.848	32.0	46	-14.03	Pass	36.7	56	-19.31	Pass
4.346	34.3	46	-11.74	Pass	37	56	-19.02	Pass
4.904	39.2	46	-6.80	Pass	40.4	56	-15.63	Pass
5.461	42.2	50	-7.81	Pass	43.4	60	-16.60	Pass
5.772	42.8	50	-7.18	Pass	44.9	60	-15.13	Pass
6.760	42.7	50	-7.25	Pass	46.2	60	-13.78	Pass
6.890	46.3	50	-3.69	Pass	48.3	60	-11.70	Pass
7.015	45.8	50	-4.22	Pass	47.9	60	-12.10	Pass
7.139	46.0	50	-4.03	Pass	48.4	60	-11.55	Pass
7.265	45.6	50	-4.44	Pass	48.6	60	-11.44	Pass
7.448	46.4	50	-3.61	Pass	48.4	60	-11.58	Pass
7.883	45.3	50	-4.65	Pass	48	60	-12.02	Pass
8.191	43.7	50	-6.26	Pass	47.1	60	-12.90	Pass
9.744	38.4	50	-11.58	Pass	42.3	60	-17.67	Pass
10.495	34.8	50	-15.22	Pass	37.9	60	-22.1	Pass
11.796	29.2	50	-20.78	Pass	31.3	60	-28.71	Pass
18.845	12.1	50	-37.94	Pass	35.3	60	-24.72	Pass



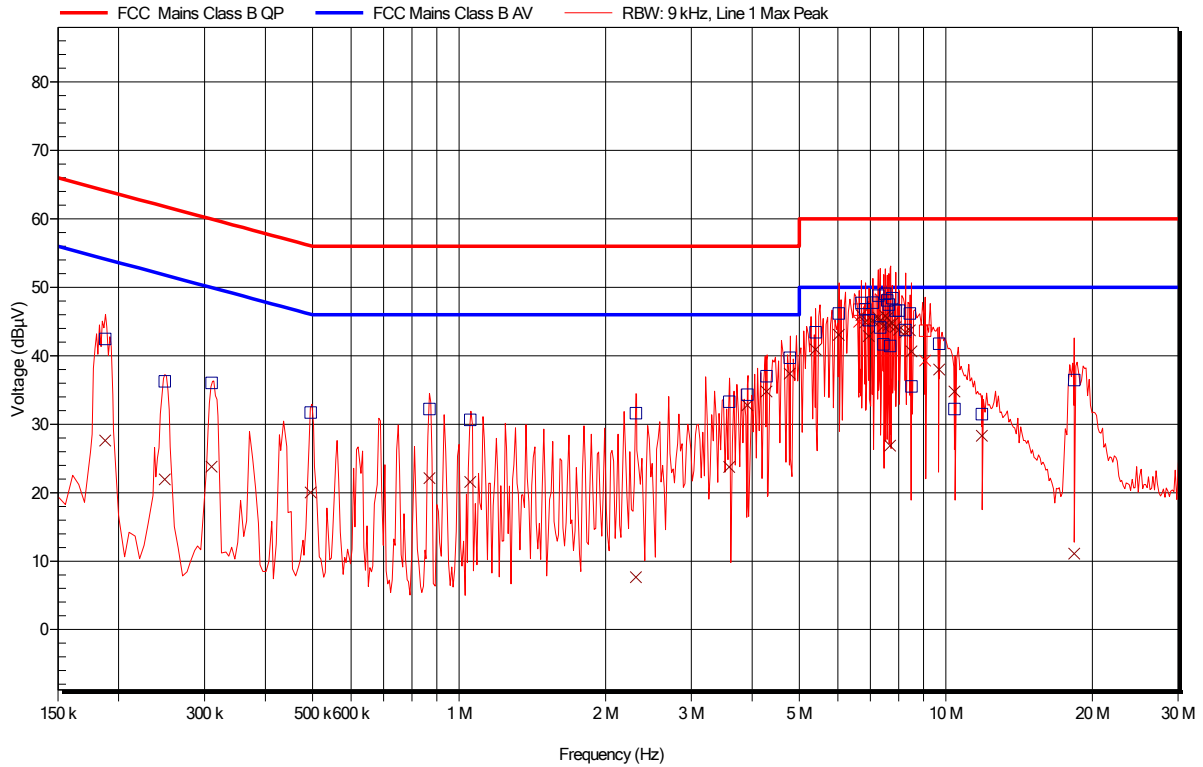
AC mains conducted emissions. WMO86916 Antenna - Operation on Middle Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.186	28.3	54.2	-25.98	Pass	43.0	64.2	-21.21	Pass
0.310	23.8	50	-26.17	Pass	36.3	60	-23.62	Pass
0.871	21.9	46	-24.09	Pass	32.2	56	-23.80	Pass
0.931	21.1	46	-24.87	Pass	31.4	56	-24.60	Pass
2.82	8.1	46	-37.91	Pass	33.4	56	-22.58	Pass
2.948	5.3	46	-40.65	Pass	28.9	56	-27.13	Pass
3.59	15.2	46	-30.82	Pass	33.0	56	-22.95	Pass
3.848	31.9	46	-14.10	Pass	35.8	56	-20.20	Pass
4.035	33.0	46	-12.96	Pass	35.5	56	-20.49	Pass
4.966	39	46	-7.00	Pass	41.3	56	-14.71	Pass
6.086	43.5	50	-6.53	Pass	45.7	60	-14.33	Pass
6.575	36.0	50	-13.97	Pass	47.0	60	-13.04	Pass
6.955	45.2	50	-4.76	Pass	47.4	60	-12.58	Pass
7.009	45.7	50	-4.29	Pass	41.4	60	-18.59	Pass
7.267	45.5	50	-4.46	Pass	48.3	60	-11.65	Pass
7.573	45.3	50	-4.72	Pass	47.2	60	-12.76	Pass
7.760	45.2	50	-4.82	Pass	48.3	60	-11.71	Pass
7.885	45.2	50	-4.85	Pass	47.4	60	-12.61	Pass
8.136	43.7	50	-6.25	Pass	46.3	60	-13.73	Pass
8.758	41.4	50	-8.64	Pass	44.5	60	-15.50	Pass
9.487	18.4	50	-31.60	Pass	40.7	60	-19.28	Pass
10.436	33.5	50	-16.49	Pass	37.5	60	-22.53	Pass
11.600	26.9	50	-23.06	Pass	32.5	60	-27.54	Pass
18.334	11.7	50	-38.29	Pass	36.8	60	-23.17	Pass



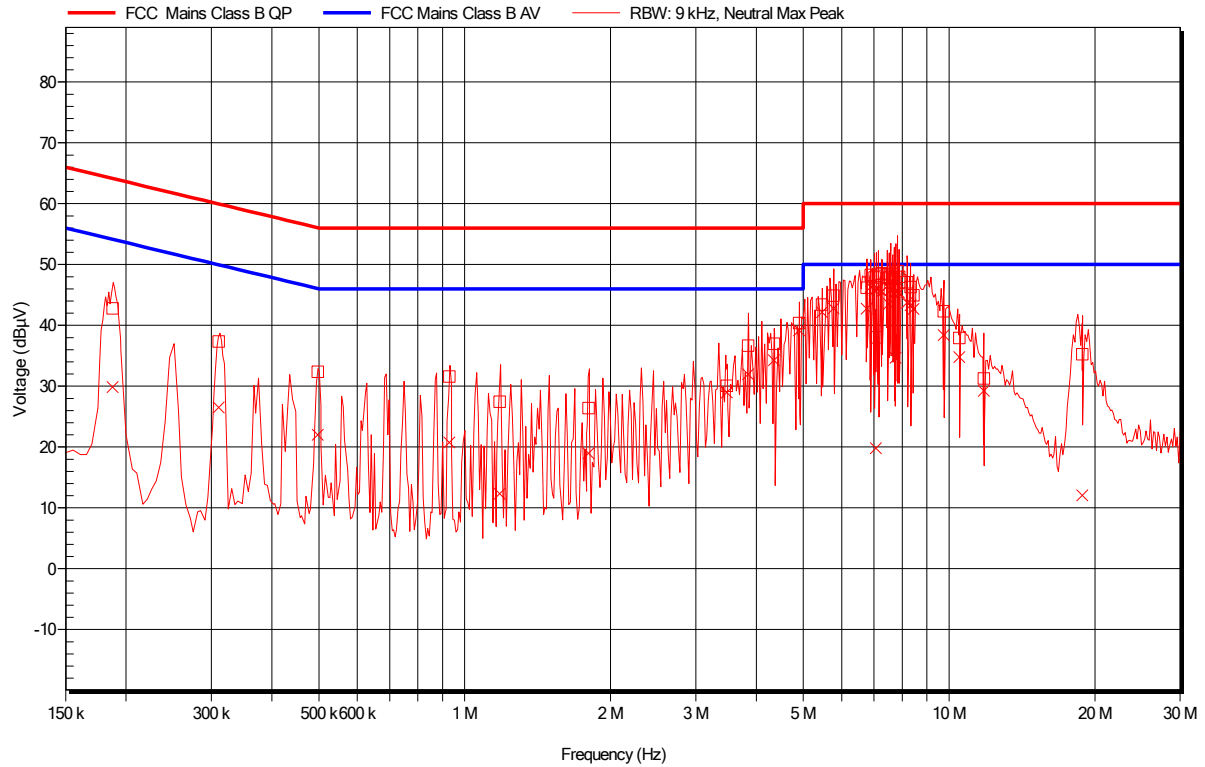
AC mains conducted emissions. WMO86916 Antenna - Operation on Middle Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.187	30.4	54.2	-23.79	Pass	43.8	64.2	-20.40	Pass
0.311	26.8	50	-23.13	Pass	37.6	60	-22.36	Pass
0.870	22.6	46	-23.41	Pass	32.9	56	-23.11	Pass
0.994	15.7	46	-30.33	Pass	29.5	56	-26.46	Pass
1.056	22.1	46	-23.88	Pass	31.7	56	-24.32	Pass
2.820	8.1	46	-37.89	Pass	33.5	56	-22.54	Pass
2.948	5.3	46	-40.65	Pass	28.8	56	-27.20	Pass
3.847	30.8	46	-15.21	Pass	36.5	56	-19.51	Pass
4.161	33.2	46	-12.80	Pass	35.5	56	-20.46	Pass
4.716	37.4	46	-8.65	Pass	38.7	56	-17.33	Pass
4.970	38.3	46	-7.74	Pass	39.3	56	-16.71	Pass
5.838	42.9	50	-7.15	Pass	44.3	60	-15.67	Pass
6.586	44.7	50	-5.33	Pass	47.1	60	-12.86	Pass
6.897	45.3	50	-4.72	Pass	48.0	60	-11.97	Pass
7.005	35.9	50	-14.08	Pass	44.4	60	-15.57	Pass
7.330	45.4	50	-4.64	Pass	48.2	60	-11.79	Pass
7.755	41.7	50	-8.29	Pass	46.8	60	-13.17	Pass
7.948	45.4	50	-4.62	Pass	48.7	60	-11.31	Pass
8.009	45.1	50	-4.95	Pass	47.5	60	-12.49	Pass
8.758	41.2	50	-8.81	Pass	45.4	60	-14.59	Pass
9.994	35.7	50	-14.35	Pass	39.2	60	-20.79	Pass
10.743	34.1	50	-15.89	Pass	36.7	60	-23.25	Pass
11.605	31.4	50	-18.57	Pass	28.5	60	-31.45	Pass
19.234	22.8	50	-27.16	Pass	32.1	60	-27.86	Pass



AC mains conducted emissions. WMO86916 Antenna - Operation on Top Channel – Live

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.187	28.5	54.2	-25.71	Pass	43.2	64.2	-20.98	Pass
0.311	23.8	49.9	-26.14	Pass	36.4	59.9	-23.58	Pass
0.435	18.6	47.2	-28.54	Pass	30.6	57.2	-26.53	Pass
0.683	21.1	46	-24.87	Pass	32.1	56	-23.94	Pass
0.870	22.3	46	-23.68	Pass	32.6	56	-23.38	Pass
1.056	22.0	46	-24.05	Pass	31.2	56	-24.80	Pass
3.204	8.4	46	-37.62	Pass	34.2	56	-21.77	Pass
3.848	31.2	46	-14.76	Pass	35.6	56	-20.42	Pass
4.101	32.4	46	-13.62	Pass	38.2	56	-17.82	Pass
4.840	36.8	46	-9.24	Pass	39.4	56	-16.65	Pass
5.027	38.8	50	-11.21	Pass	38.6	60	-21.36	Pass
5.278	41.6	50	-8.38	Pass	42.9	60	-17.12	Pass
5.894	40.0	50	-10.02	Pass	44.5	60	-15.49	Pass
6.523	44.6	50	-5.42	Pass	46.3	60	-13.65	Pass
6.767	44.8	50	-5.24	Pass	47.8	60	-12.20	Pass
7.010	41.1	50	-8.92	Pass	43.7	60	-16.31	Pass
7.578	44.8	50	-5.18	Pass	48.0	60	-11.96	Pass
7.949	44.9	50	-5.14	Pass	48.1	60	-11.91	Pass
8.258	40.0	50	-9.97	Pass	46.0	60	-13.98	Pass
8.443	42.6	50	-7.43	Pass	45.7	60	-14.33	Pass
9.371	36.3	50	-13.75	Pass	34.8	60	-25.20	Pass
10.427	31.9	50	-18.06	Pass	35.8	60	-24.24	Pass
12.044	25.6	50	-24.40	Pass	29.0	60	-30.99	Pass
18.591	9.3	50	-40.66	Pass	34.5	60	-25.51	Pass



AC mains conducted emissions. WMO86916 Antenna - Operation on Top Channel – Neutral

Frequency (MHz)	Average (dBμV)	Average Limit (dBμV)	Average Difference (dB)	Average Status	Quasi-Peak (dBμV)	Quasi-Peak Limit (dBμV)	Quasi-Peak Difference (dB)	Quasi-Peak Status
0.187	30.6	54.2	-23.62	Pass	43.8	64.2	-20.37	Pass
0.310	27.1	50	-22.91	Pass	37.8	60	-22.18	Pass
0.683	21.9	46	-24.11	Pass	32.6	56	-23.39	Pass
0.870	22.7	46	-23.32	Pass	33.2	56	-22.84	Pass
1.056	22.1	46	-23.87	Pass	31.8	56	-24.16	Pass
1.553	17.2	46	-28.77	Pass	28.3	56	-27.67	Pass
2.175	17.2	46	-28.79	Pass	25.2	56	-30.84	Pass
3.205	8.4	46	-37.62	Pass	34.3	56	-21.68	Pass
3.726	30.4	46	-15.61	Pass	31.5	56	-24.45	Pass
4.404	26.3	46	-19.73	Pass	35.9	56	-20.06	Pass
4.964	40.2	46	-5.81	Pass	41.1	56	-14.90	Pass
6.025	43.7	50	-6.30	Pass	47.2	60	-12.80	Pass
6.205	33.9	50	-16.06	Pass	44.0	60	-16.03	Pass
6.894	46.3	50	-3.66	Pass	48.4	60	-11.56	Pass
7.015	42.6	50	-7.39	Pass	45.3	60	-14.74	Pass
7.143	46.2	50	-3.75	Pass	48.4	60	-11.64	Pass
7.389	45.1	50	-4.86	Pass	48.5	60	-11.52	Pass
7.640	45.9	50	-4.07	Pass	48.3	60	-11.69	Pass
7.951	45.2	50	-4.80	Pass	48.2	60	-11.80	Pass
8.012	45.1	50	-4.89	Pass	47.2	60	-12.82	Pass
8.755	39.6	50	-10.36	Pass	44.7	60	-15.35	Pass
9.440	39.5	50	-10.51	Pass	41.9	60	-18.06	Pass
10.421	17.7	50	-32.25	Pass	33.4	60	-26.62	Pass
17.947	17.7	50	-32.31	Pass	32.8	60	-27.21	Pass

Appendix A EUT Test Photos

Test set up photographs are supplied separately.

Appendix B Test Equipment List

Conducted Emissions from Antenna Port

Item	Serial No.	Last Calibration Date	Calibration Interval
RF Cable	Cable 9	January 2021	12 Months
Keysight MXE EMI Receiver	MY51210185	19 th October 2020	12 Months

AC Mains conducted emissions equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Rohde & Schwarz ESR7 Test receiver	-	26 th January 2021	12 Months
Cables J7, J9 and LF3	-	January 2021	12 Months
Rohde & Schwarz ESH3-Z5 LISN 78119	-	25 th January 2021	12 Months
Teseq CFL 9206A transient limiter 10dB 9kHz - 30MHz	-	6 th January 2021	12 Months
Kikusui PCR2000M power supply	-	-	-

Radiated Emissions Equipment

Item	Serial No.	Last Calibration Date	Calibration Interval
Laboratory 1 Semi-Anechoic Chamber	Lab 1	28 th January 2020	36 Months
ETS Lindgren 2017B Mast (1 – 4m) with tilting mechanism	--	N/A	N/A
R & S ESR	C0499	26 th January 2021	12 Months
Chase CBL6112B Bilog Antenna, 78167	1503	13 th December 2019	36 Months
6dB Attenuator (For use with Bilog Antenna)	78708B	13 th December 2019	36 Months
HF26 Cable	167003-001	5 th January 2021	12 Months
HF17 Cable	167002-001	5 th January 2021	12 Months
HF27 Cable	-	5 th January 2021	12 Months
STLP9148 SCHWARZBECK Antenna 1-18GHz stacked LogPeriodic	C0626	13 th November 2020	12 Months
BONN BLMA 0118-5A Preamplifier	149759	9 th March 2021	12 Months