

RADIO TEST REPORT

FCC TITLE 47 PART 15C

Client: Headsafe MGF Pty., Ltd.
Address: 61 Marlborough Street, Surry Hills, NSW 2010, AUSTRALIA
Report Number: 0323HEA_NUROCHEK-I_FCC15C
Date of Testing: 1st May 2020 to 12th March 2021
Austest File Number: HEA200923

Equipment Name: Nurochek Headset
Model Number: NUROCHEK-I
FCC ID: 2AXMCHS01-001
Description: VEP Headset

Result: **COMPLIED**

Tests supervised by Richard Turner
Test Engineer
Approved by: Rob Weir
Assessment Engineer
Date of Issue: 23rd March 2021



Results appearing herein relate only to the sample(s) tested.
This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion.

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TABLE OF CONTENTS

1	REPORT REVISION HISTORY	3
2	RESULT SUMMARY	3
3	MODIFICATIONS	3
4	REFERENCES.....	4
5	EQUIPMENT UNDER TEST (EUT) DESCRIPTION	4
6	EUT TEST SETUP AND CONFIGURATION.....	4
7	TEST SPECIFICATIONS	5
8	ANTENNA REQUIREMENT, §15.203.....	6
9	RESTRICTED BANDS OF OPERATION, §15.205.....	6
10	CONDUCTED LIMITS, §15.207	6
11	DTS BANDWIDTH, §15.247(a)(2)	7
12	EQUIVALENT PEAK CONDUCTED OUTPUT POWER, §15.247(b)(3)	8
13	OUT OF BAND EMISSIONS, §15.247(d) AND §15.209	9
14	POWER SPECTRAL DENSITY, §15.247(e).....	23
15	MAXIMUM PERMISSIBLE EXPOSURE (MPE), §15.247(i).....	24

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1 REPORT REVISION HISTORY

Date	Report Number	Changes
15 Dec. 2020	1215HEA_NUROCHEK-I_FCC15C	Original report.
18 Jan. 2021	0118HEA_NUROCHEK-I_FCC15C	Revised to address TCB points.
18 Mar. 2021	0318HEA_NUROCHEK-I_FCC15C	Added revised band-edge measurements to address TCB comment.
23 Mar. 2021	0323HEA_NUROCHEK-I_FCC15C	Added comment regarding 1 MHz BW measurements for 15.247(d) to address TCB comment.

2 RESULT SUMMARY

DISCLAIMER: Austest Laboratories makes no claim regarding the consistency of production versions of the EUT. The results in this report apply only to the sample tested, as described in Section 5 of this report.

FCC Part 15, Subpart C – Intentional Radiators		Result	Notes
15.203	Antenna Requirement	Complied	-
15.205	Restricted Bands of Operation	Complied	-
15.207	Conducted Limits	N.A.	(i)
15.209	Radiated Emission Limits, General Requirements	Complied	-
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	Complied	-
15.247(a)(2)	DTS Bandwidth	Complied	-
15.247(b)(3)	Equivalent Peak Conducted Output Power	Complied	-
15.247(d)	Out of band emissions	Complied	-
15.247(e)	Power Spectral Density	Complied	-
15.247(i)	Maximum Permissible Exposure (MPE)	Complied	-
2.1049	99% Bandwidth	Noted	-

Notes:

- (i) Not applicable as the EUT was powered by internal batteries and the radio operation was disconnected when batteries were charged.

3 MODIFICATIONS

No modifications were made to the sample.

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4 REFERENCES

FCC Title 47 Part 15 current as of June 2019
ANSI C63.10: 2013
KDB Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
KDB Publication 447498 D01 15.247 General RF Exposure Guidance v06, Oct. 23, 2015

5 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	Nurochek Headset
Description:	VEP Headset
Model:	NUROCHEK-I
FCC ID:	2AXMCHS01-001
Power Supply & Rating:	LiPo battery
Highest Frequency:	2480 MHz
Lowest Frequency:	32.768 kHz
Frequency Range:	2402 MHz to 2480 MHz
Transmit Power:	-1.87 dBm
Modulation Technique:	DTS, Bluetooth Low Energy (BLE): GFSK
Number of Channels:	40
Antenna Specifications:	Maximum gain: 0 dBi (declared)

6 EUT TEST SETUP AND CONFIGURATION

Refer to the photographs in APPENDIX D – EUT TEST SETUP PHOTOGRAPHS for the EUT test setup and physical configuration.

Modified samples were provided with an additional interface added to connect a laptop for programming the radio into the various states. One sample was also provided with a temporary antenna port for conducted tests.

6.1 EUT Operating Modes

Mode No.	Operating Mode Description
1	Constant transmission with modulation, on Ch 0 (2402 MHz).
2	Constant transmission with modulation, on Ch 19 (2440 MHz).
3	Constant transmission with modulation, on Ch 39 (2480 MHz).
4	Constant Frequency Hopping with modulation

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7 TEST SPECIFICATIONS

7.1 Test Facility

Testing was performed at Austest Laboratories test facilities located at 2/9 Packard Avenue in Castle Hill, New South Wales, Australia.

7.2 Accreditations and Listings

Test facilities at Austest Laboratories are accredited by A2LA, Certificate Number 2765.02. The tests reported herein have been performed in accordance with its terms of accreditation.

Austest Laboratories Yarramalong and Castle Hill test facilities are accredited with the FCC under the ACMA-FCC APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

Austest Laboratories Yarramalong and Castle Hill test facilities are accredited with the with Innovation, Science and Economic Development Canada under the ACMA-FCC APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

7.3 Deviations from Standards and/or Accreditations

None.

7.4 Measurement Uncertainties

The following uncertainties are for a 95% level of confidence, based on a coverage factor, $k=2$.

Measurement	Uncertainty	
	U_{cispr}	U_{Lab}
RF Frequency	-	± 5 part in 10^{10}
RF power conducted	-	$\pm 1.3\text{dB}$
Radiated Emissions – 30 MHz to 1000 MHz	6.3 dB	± 4.7 dB
Radiated Emissions – 1 GHz to 6 GHz	5.2 dB	± 4.9 dB
Radiated Emissions – 6 GHz to 18 GHz	5.5 dB	± 4.9 dB

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7.5 Test Equipment

ID	Brand/Model	Description	Calibration (dd/mm/yyyy)	
			Last	Due
72	HP8574B	Spectrum Analyser / EMI Rx	07/11/2019	07/11/2021
74	HP8447x	RF Preamp	08/10/2018	08/10/2020
83	OATS 1	3m/10m Open Area Test Site	16/01/2020	16/01/2022
225	EM6876	Active Loop Antenna	13/01/2020	13/01/2022
320	Chroma 6912	AC Source	Verified	
530	Com-Power SAS/571	DRG Horn	17/08/2017	17/08/2020
1346	PAM-118A	RF Preamp	17/08/2018	17/08/2020
1385	FSP40	Spectrum Analyser 40GHz	11/10/2019	11/10/2021
1590	Ametek CBL6141B	Bilog Antenna	24/06/2019	24/06/2020
-	Huber + Suhner	Coax Cables	14/01/2020	14/01/2022
-	HP85869C	Test Software	Verified	
-	RS Commander	Data capture software	Verified	

8 ANTENNA REQUIREMENT, §15.203

The EUT complied with the requirement of this Section since the EUT antenna was integral and had no external antenna port.

9 RESTRICTED BANDS OF OPERATION, §15.205

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation. Out of band emissions falling within the Restricted Bands of Operation were found to be below limits specified in FCC section 15.209.

10 CONDUCTED LIMITS, §15.207

Not applicable as the EUT was only powered from a battery pack. The radio operation was disconnected when the battery was being charged.

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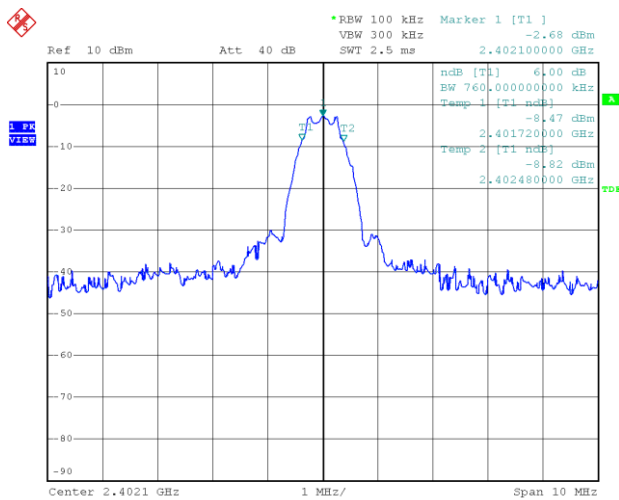


11 DTS BANDWIDTH, §15.247(a)(2)

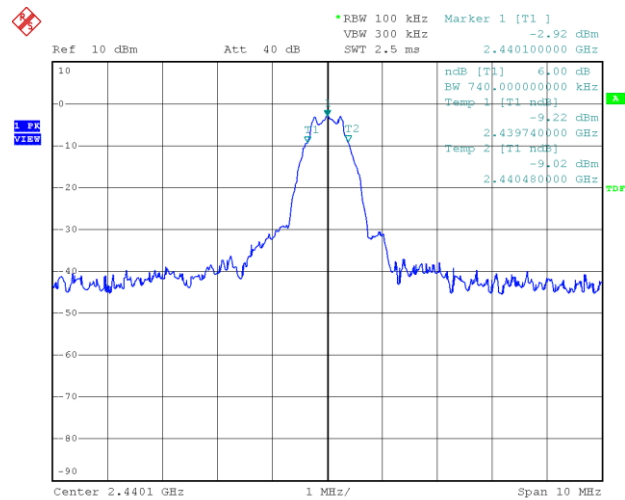
Measurements were performed on the sample with a temporary antenna port by applying the procedure detailed in ANSI C63.10, Clause 11.8.1 DTS Bandwidth Option 1.

The 6 dB bandwidth was calculated using the analyser ndB down marker function.

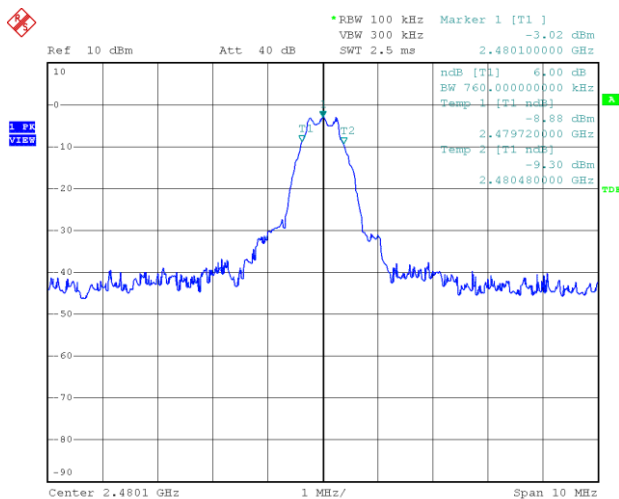
Channel	6 dB Bandwidth (kHz)
0	760
19	740
39	760



DTS Bandwidth – Ch 0



DTS Bandwidth – Ch 19



DTS Bandwidth – Ch 39

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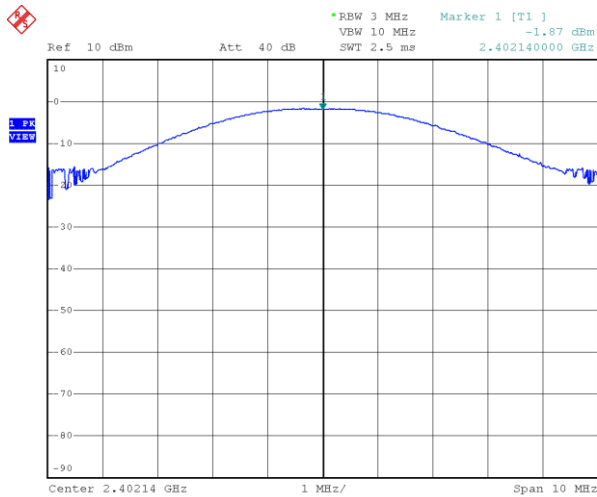


12 EQUIVALENT PEAK CONDUCTED OUTPUT POWER, §15.247(b)(3)

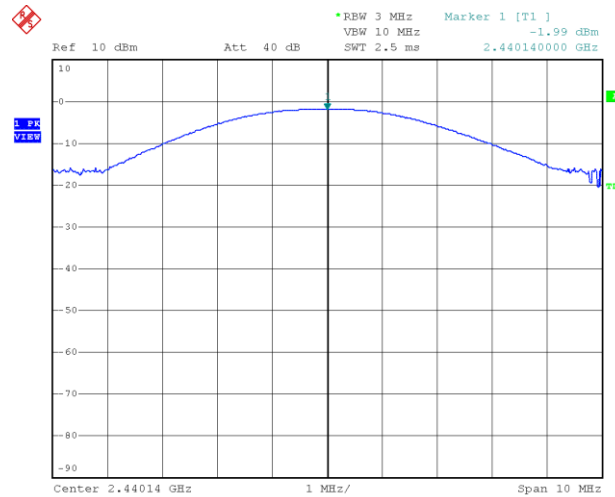
Measurements were performed on the sample with a temporary antenna port by applying the procedure detailed in ANSI C63.10, Clause 11.9.1.1 RBW \geq DTS Bandwidth.

The power was measured directly from the marker results, the cable and antenna loss used for the conducted measurements were compensated for.

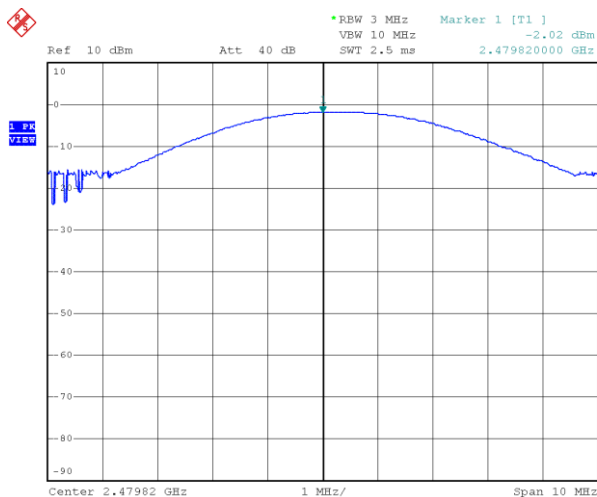
Channel	Peak Conducted Power		Limit W	Margin W
	dBm	W		
0	-1.87	0.001	1.000	0.999
19	-1.99	0.001	1.000	0.999
39	-2.02	0.001	1.000	0.999



Conducted Power – Ch 0



Conducted Power – Ch 19



Conducted Power – Ch 39

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13 OUT OF BAND EMISSIONS, §15.247(d) AND §15.209

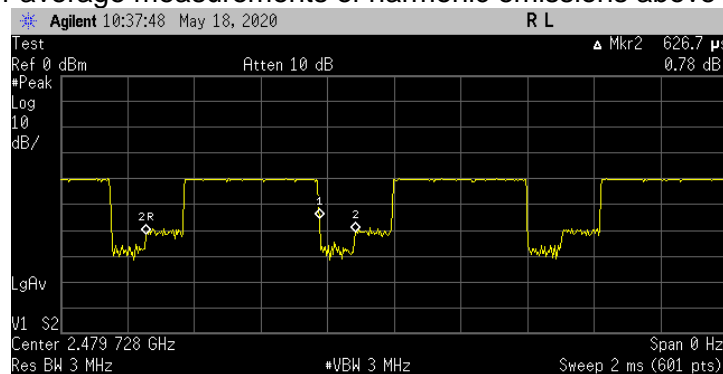
Test Dates: 18-21 May 2020 and 12 March 2021 Temperature: 21-24°C
Test Officer: Richard Turner, Anthony Mancini Humidity: 53-60%RH
Test Location: Austest Laboratories (Castle Hill, NSW)

13.1 EUT Operating Mode

- Channels: 0, 19 and 39.
- Sample orientation: Three orthogonal axes.
- Restricted band limits of 15.209 was applied for the whole range.
- Channel and sample orientation producing worse case results have been reported.

13.2 Test Method

- Measurements were performed in accordance with the ANSI C63.10: 2013, Clause 11.12.1 radiated emission measurements.
- Minimum VBW for average measurements of harmonic emissions above 1 GHz:



- $T = t_{ON} = 400 \mu s$
- $VBW \geq 1 / T = 2500 \text{ Hz}$
- Measuring receiver settings:

Frequency Range	Antenna	Measurement	Detector	RBW	VBW
0.15 to 30 MHz	60 cm Loop	Pre-scan	Peak	9 kHz	30 kHz
		Final Quasi-Peak	Quasi-Peak	9 kHz	-
30 to 1000 MHz	Hybrid (bicon/log)	Pre-scan	Peak	120 kHz	300 kHz
		Final Quasi-Peak	Quasi-Peak	120 kHz	-
Above 1000 MHz	Double-ridged guide horn	Pre-scan - Peak	Peak	1 MHz	3 MHz
		Pre-scan - Ave.	Peak	1 MHz	100 Hz
		Final Peak	Peak	1 MHz	3 MHz
		Final Average	Peak	1 MHz	3 kHz

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- For measurements below 1 GHz the EUT was set up on a non-conductive support that was positioned on a turntable and 0.8 m above the conductive ground plane at the indicated test distance away from the measuring antenna.
- For measurement above 1 GHz the EUT was set up on a non-conductive support that was positioned on a turntable and 1.5 m above the conductive ground plane at the indicated test distance away from the measuring antenna. RF absorber was placed between the EUT and measuring antenna to simulate free-space conditions.
- Pre-scans using a peak detector were performed initially and emissions from the EUT were identified.
- Each identified emission was maximised by rotating the EUT through 360° and adjusting the measuring antenna height between 1 m and 4 m in the vertical and horizontal orientations.

13.3 Example Calculation

The final field strength levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

Calculation	Example	
$E = V + AF + L_{cbl} - G_{pre}$	$V = 40.0 \text{ dB}\mu\text{V}$ $AF = 12.0 \text{ dB/m}$	$L_{cbl} = 2.9 \text{ dB}$ $G_{pre} = 22.5 \text{ dB}$ $E = 40 + 12 + 2.9 - 22.5$ $= 32.4 \text{ dB}\mu\text{V/m}$

Where

- E = Radiated Electric Field Strength in dB μ V/m,
- V = EMI Receiver measured signal input voltage in dB μ V,
- AF = Antenna Factor of the measuring antenna in dB/m,
- L_{cbl} = Total cable insertion loss in dB and
- G_{pre} = Preamplifier gain in dB.

13.4 Test Results

Frequency range: 9 kHz to 25 GHz.

All measured out of band emission levels were below the 15.209 limits.

9 kHz to 30 MHz:

All emissions were greater than 20 dB below the limits specified in section FCC 15.209.

30 MHz to 1 GHz:

All emissions were greater than 10 dB below the limits specified in section FCC 15.209.

Above 1 GHz:

All Peak detector emissions were below the FCC 15.209 average detector limits.

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13.4.1 Spurious Emissions: 9 kHz to 150 kHz at 10 m distance

9kHz to 150kHz measured at 10 meters.

Measured data extrapolated to distance defined by limits (300m for 9-490kHz and 30m for 490kHz – 30MHz).

In accordance with ANSI C63.10 Clause 6.4.4.1:

Below 15.9MHz used 40dB/decade extrapolation.

Where 15.9MHz calculated as the near field point for 3 meter measurements.

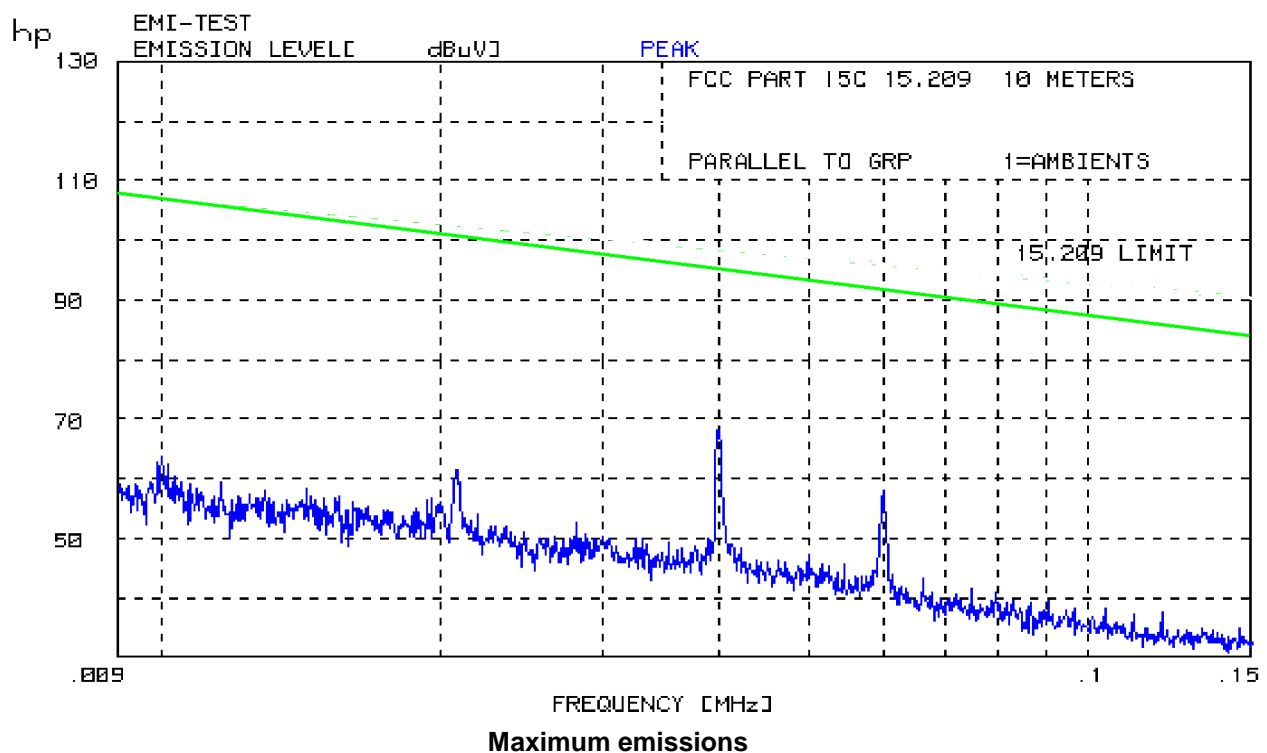
Measurements were performed both on an OATS ground plane and also over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

Prescan results were used to identify the orientation that produced the highest measured emissions in the three antenna positions, Coaxial, Coplanar and Parallel. Plots with maximum emissions shown.

Emission levels were not affected by RF channel selection.

Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)

Worse case Antenna orientation = Parallel Ground



Emissions marked '1' are ambient

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13.4.2 Spurious Emissions: 150 kHz to 30 MHz at 3 m distance

150kHz to 30MHz measured at 3 meters.

Measured data extrapolated to distance defined by limits (300m for 9-490kHz and 30m for 490kHz – 30MHz).

In accordance with ANSI C63.10 Clause 6.4.4.1:

Below 15.9MHz used 40dB/decade extrapolation.

Above 15.9MHz used 20dB/decade extrapolation.

Where 15.9MHz calculated as the near field point for 3 meter measurements.

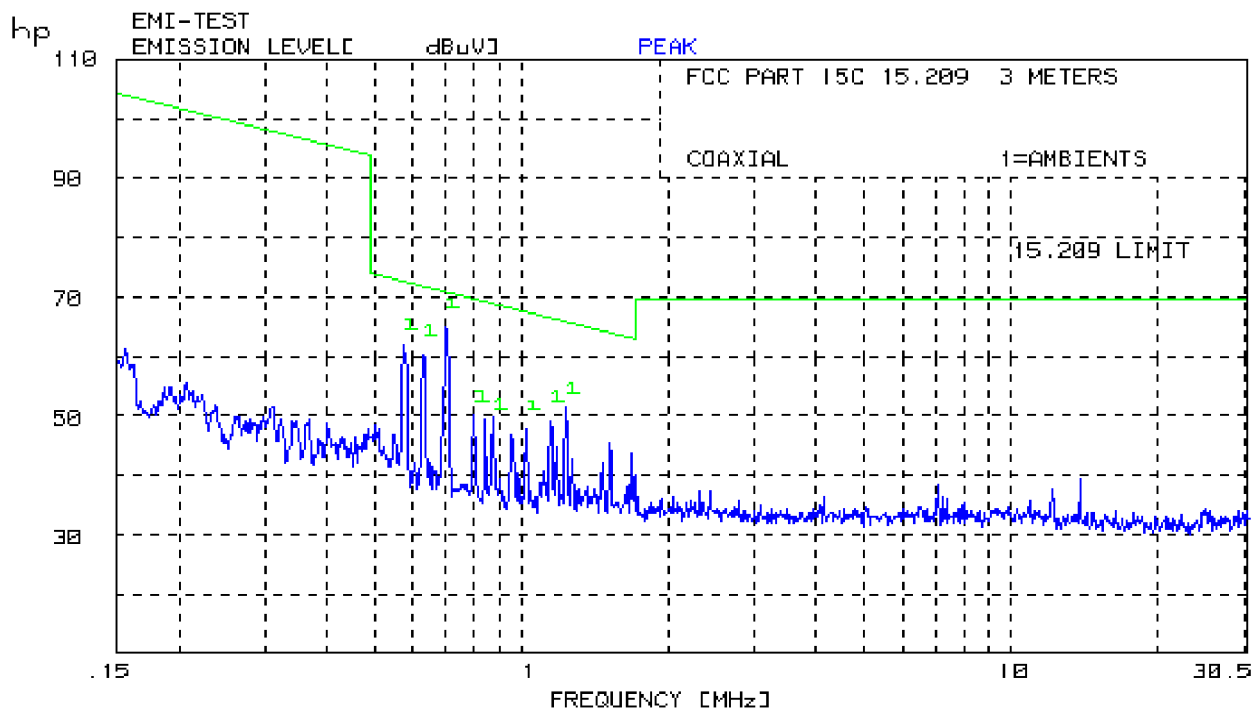
Measurements were performed both on an OATS ground plane and also over a non-conductive ground plane as specified in ANSI C63.10:2013, clause 5.2.

Prescan results were used to identify the orientation that produced the highest measured emissions in the three antenna positions, Coaxial, Coplanar and Parallel. Plots with maximum emissions shown.

Emission levels were not affected by RF channel selection.

Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)

Worse case Antenna orientation = Perpendicular



Maximum emissions

Emissions marked '1' are ambient

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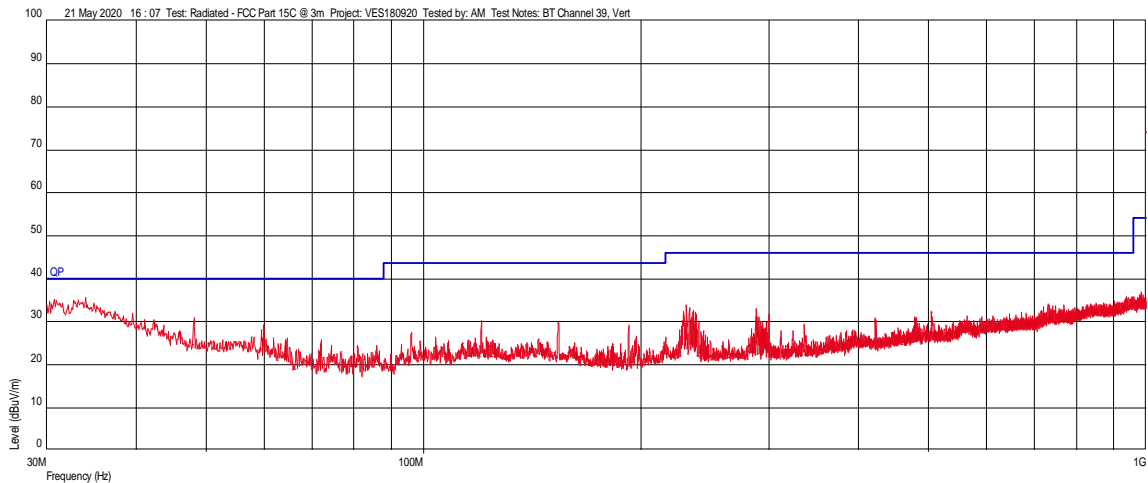
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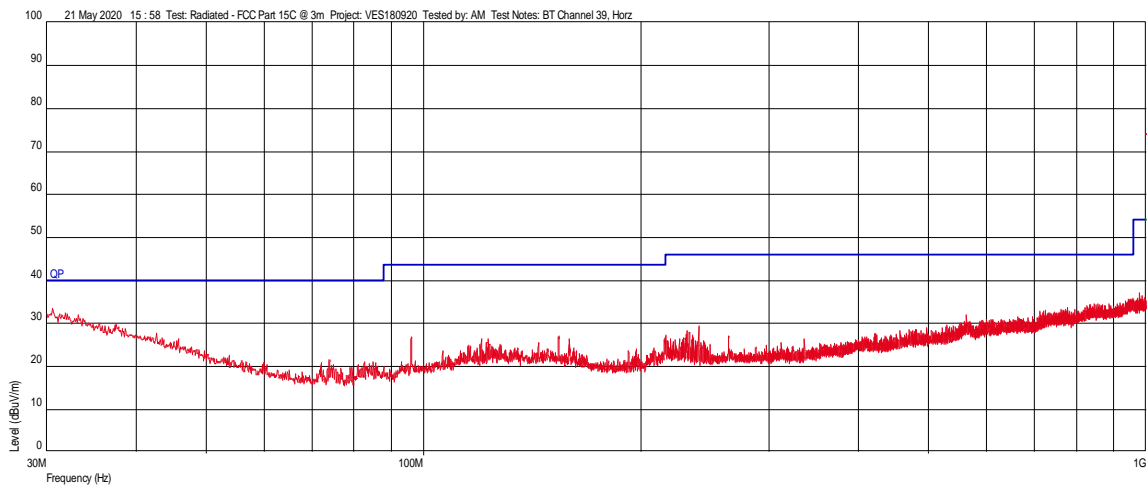
13.4.3 Spurious Emissions: 30 MHz to 1000 MHz at 3m distance

Emission levels were not affected by RF channel selection.

Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz - Horizontal)

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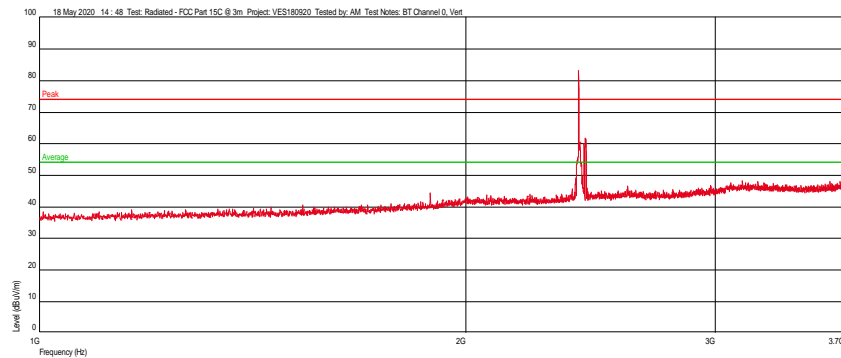
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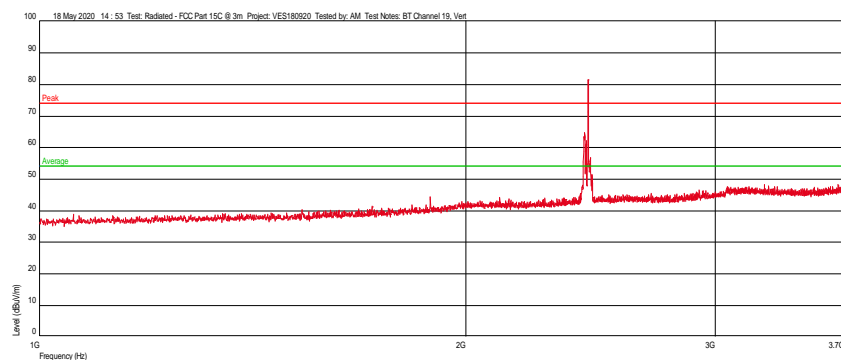


13.4.4 Spurious Emissions: 1 GHz to 3.7 GHz at 3 m distance

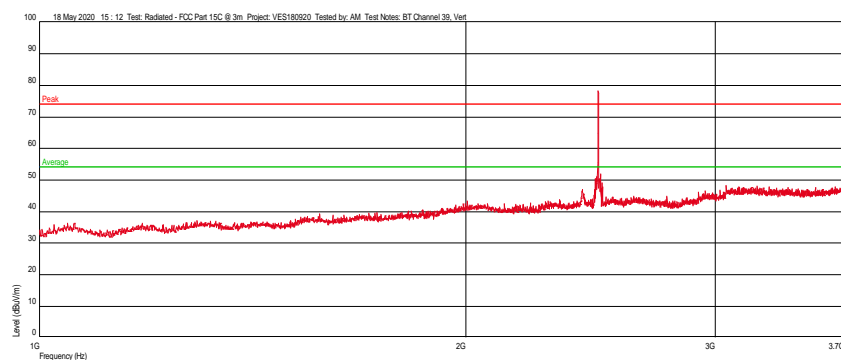
Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



Ch 0 – Peak Vertical Polarisation



Ch 19 – Peak Vertical Polarisation



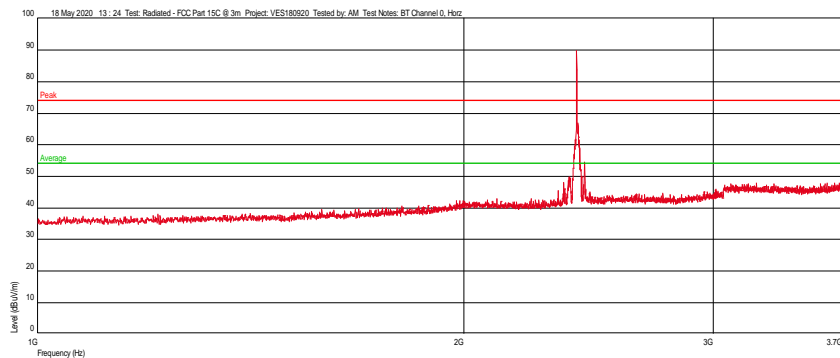
Ch 39 – Peak Vertical Polarisation

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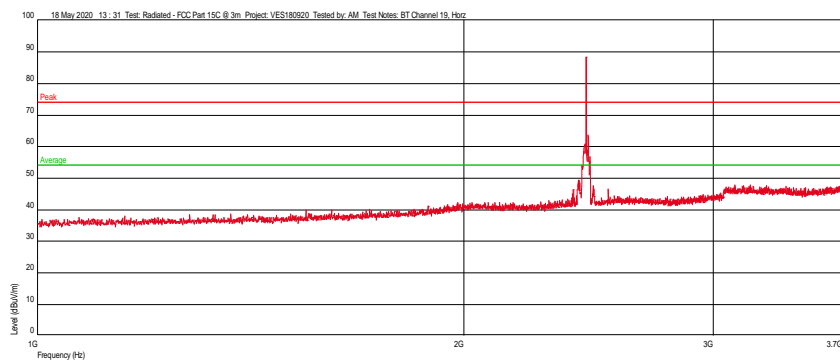
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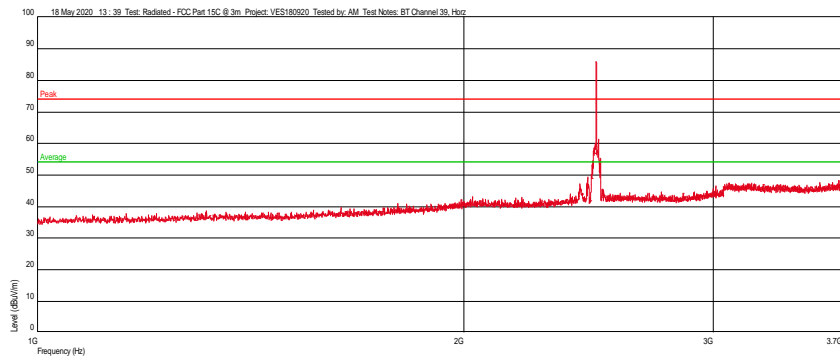




Ch 0 – Peak Horizontal Polarisation



Ch 19 – Peak Horizontal Polarisation



Ch 39 – Peak Horizontal Polarisation

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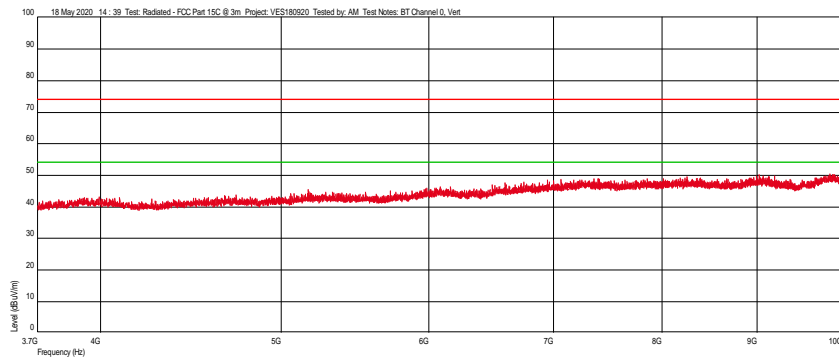
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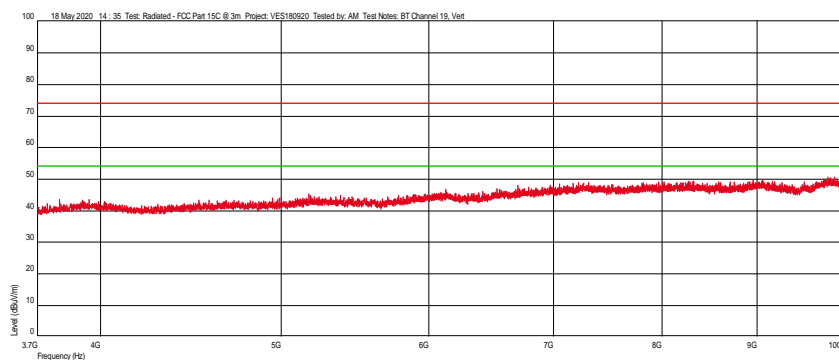


13.4.5 Spurious Emissions: 3.7 GHz to 10 GHz at 3 m distance

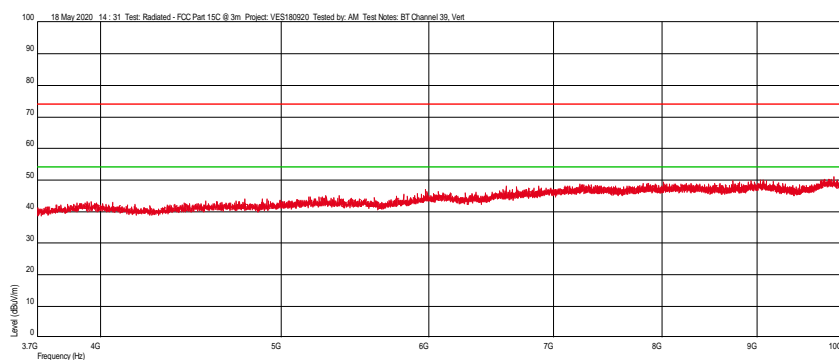
Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



Ch 0 – Peak Vertical Polarisation



Ch 19 – Peak Vertical Polarisation



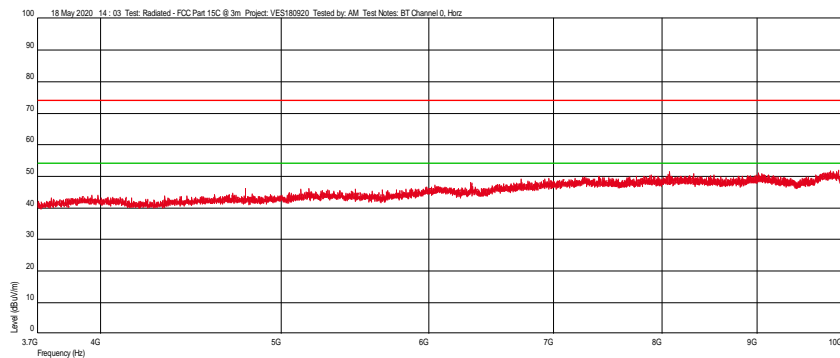
Ch 39 – Peak Vertical Polarisation

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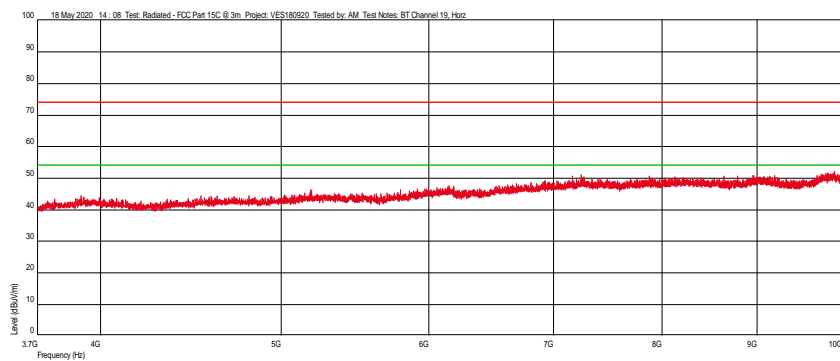
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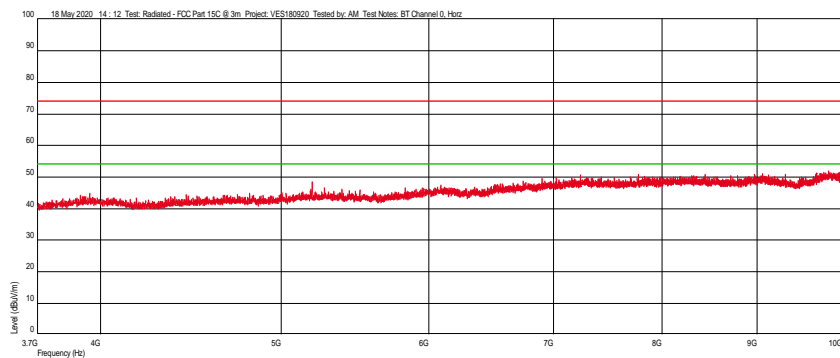




Ch 0 – Peak Horizontal Polarisation



Ch 19 – Peak Horizontal Polarisation



Ch 39 – Peak Horizontal Polarisation

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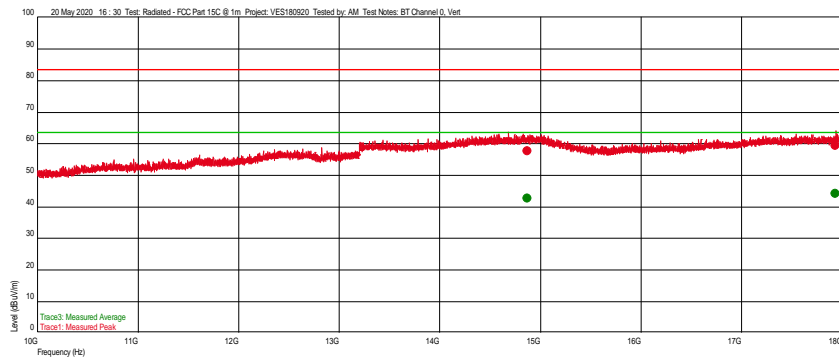
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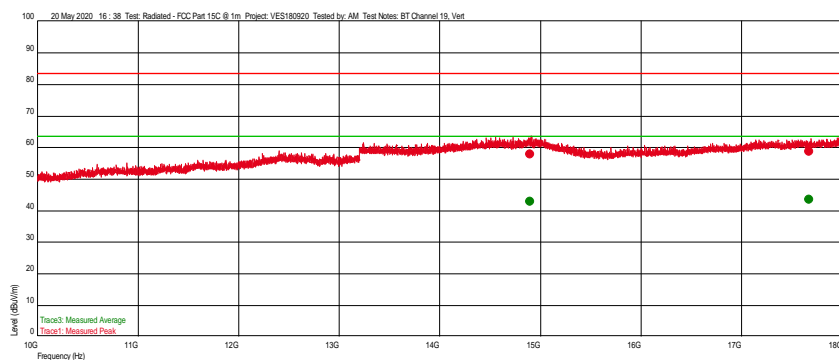


13.4.6 Spurious Emissions: 10 GHz to 18 GHz at 3 m distance

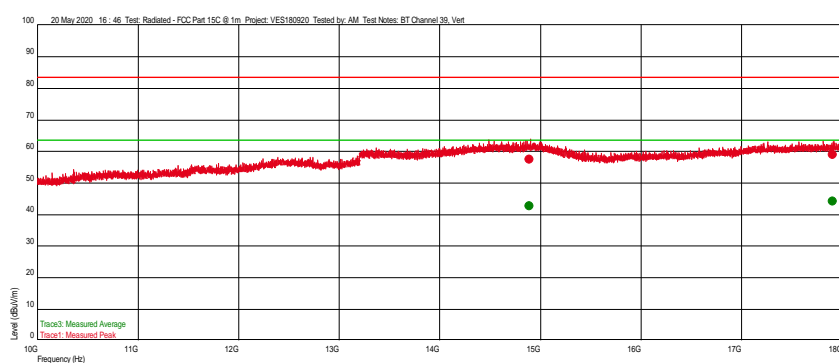
Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



Ch 0 – Peak Vertical Polarisation



Ch 19 – Peak Vertical Polarisation



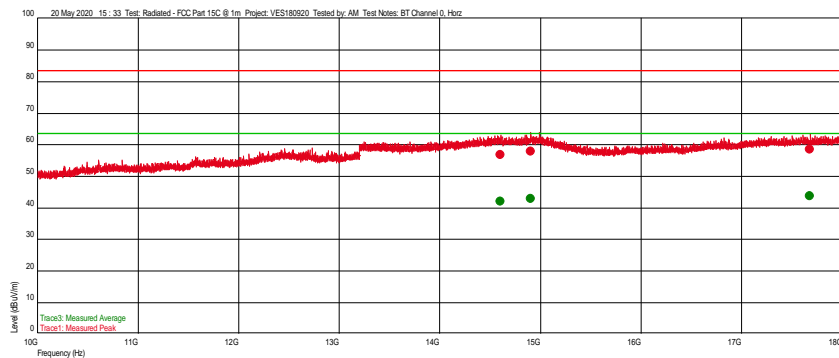
Ch 39 – Peak Vertical Polarisation

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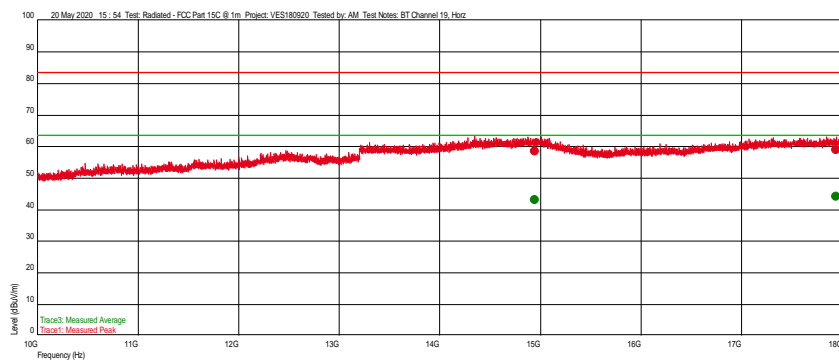
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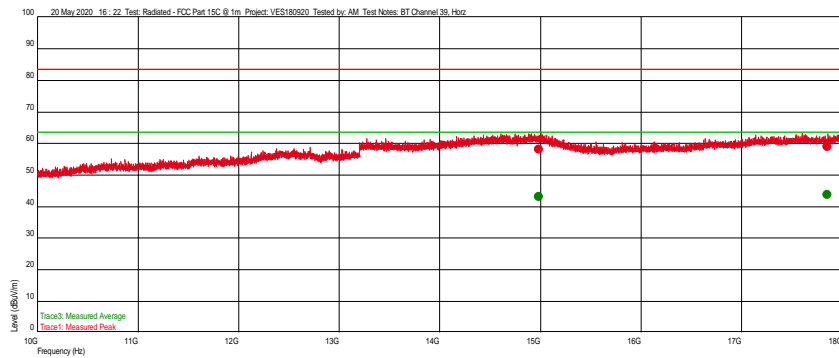




Ch 0 – Peak Horizontal Polarisation



Ch 19 – Peak Horizontal Polarisation



Ch 39 – Peak Horizontal Polarisation

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13.4.7 Spurious Emissions: 18 GHz to 25 GHz at 1 m distance

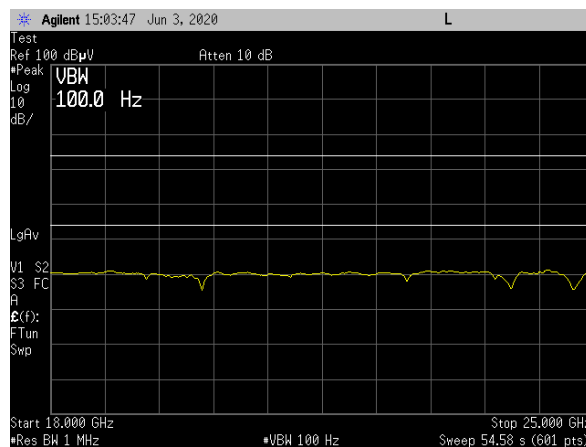
Measured field strength levels performed at a 1 meter distance were extrapolated to a 3 meter distance using the extrapolation factor of 20 dB/decade.

All intentional radiation spurious were greater than 10 dB below the limits specified in FCC 15.209.

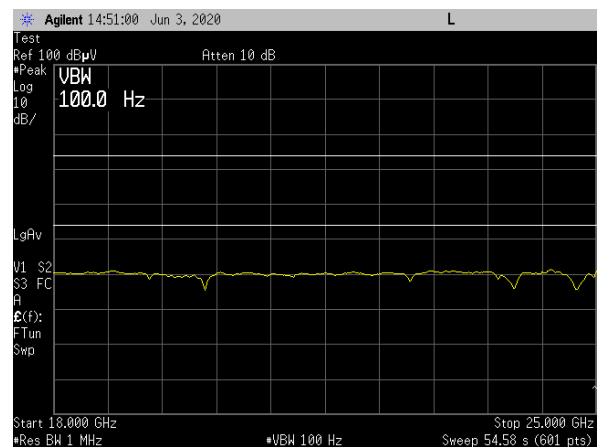
Emission levels were not affected by RF channel selection.

Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)

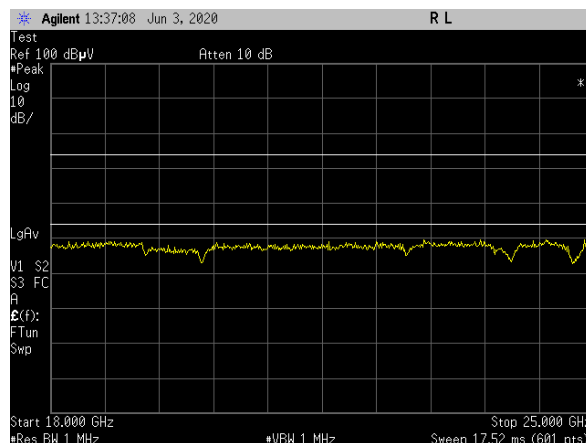
Following plots indicate limits calculated for a 1 m distance.



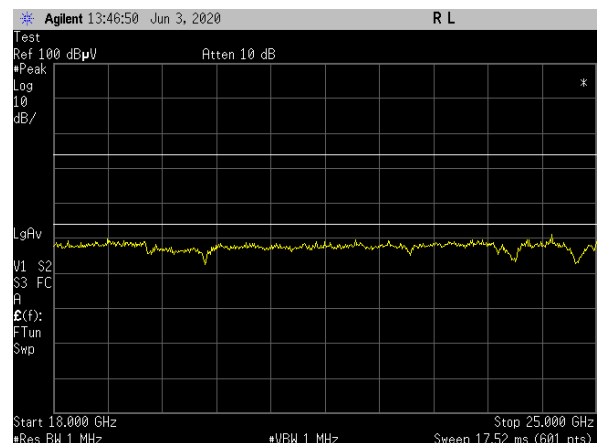
Average Vertical Polarisation



Average Horizontal Polarisation



Peak Vertical Polarisation



Peak Horizontal Polarisation

Lower display line = average limit
Upper display line = peak limit

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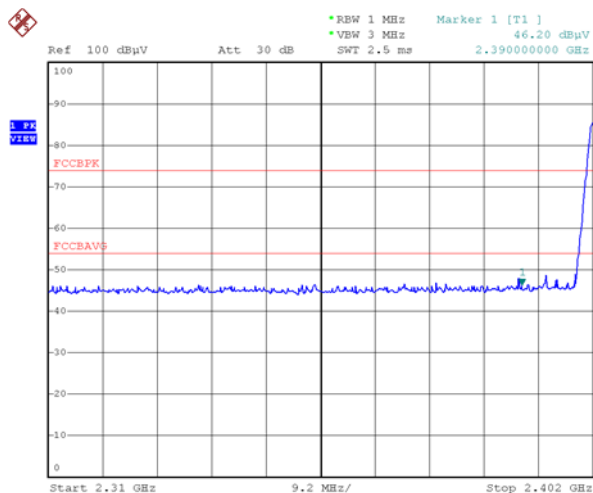


13.5 Band edge measurements

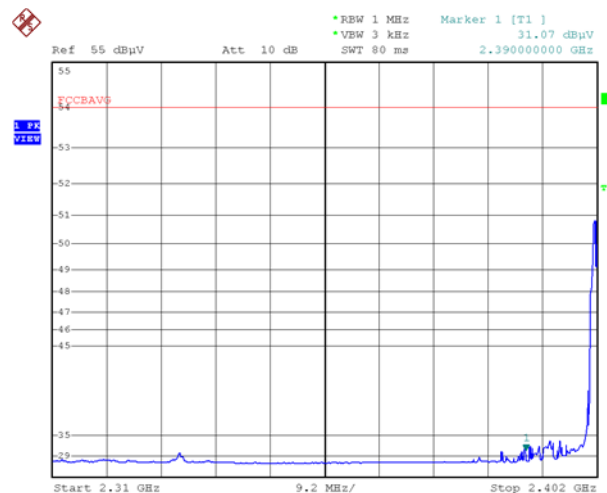
Restricted band 2310 to 2390MHz, Radiated at 3 meters.

All measured disturbances were greater than 20dB below the FCC15.209 average limit, and greater than 20dB below the peak limit.

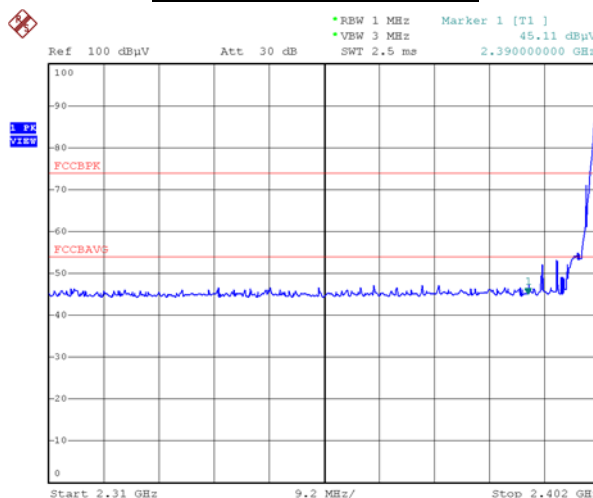
Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



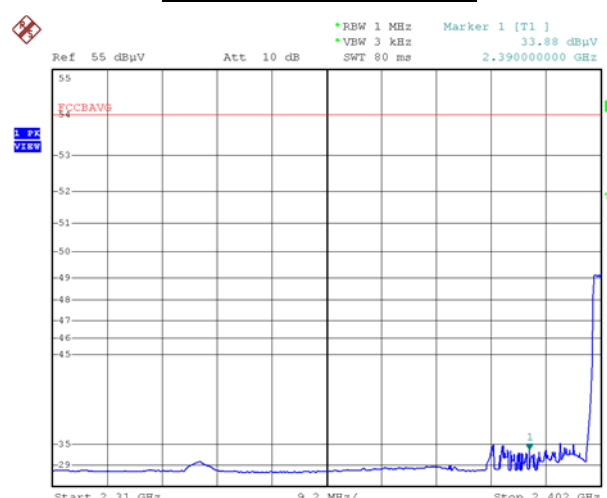
Peak Vertical Polarisation



Avg Vertical Polarisation



Peak Horizontal Polarisation



Avg Horizontal Polarisation

Lower display line = average limit
Upper display line = peak limit

The limit for the range 2390 to 2400 MHz was 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, the measured level met this requirement using a wider 1 MHz bandwidth and therefore deemed compliant.

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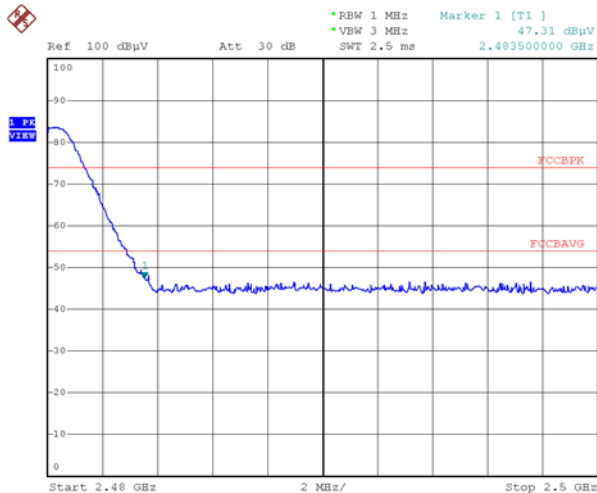
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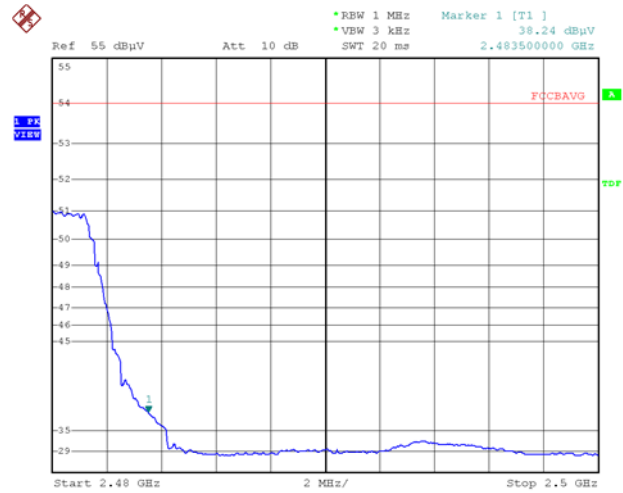
Restricted band 2483.5 to 2500MHz, Radiated at 3 meters.

All measured disturbances were greater than 20dB below the FCC15.209 average limit, and greater than 10dB below the peak limit.

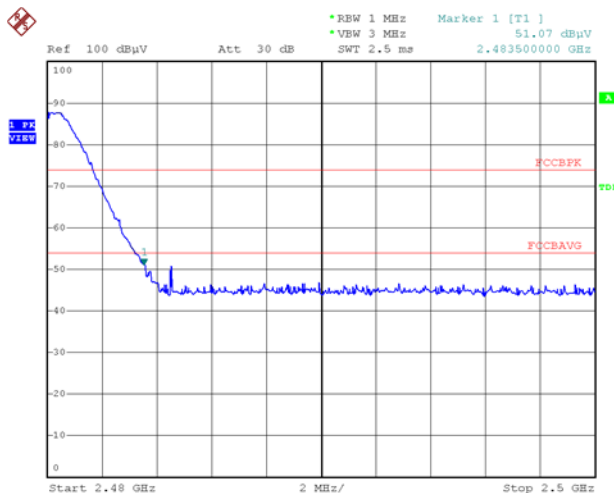
Worse case orientation scan provided = XZ Plane (refer Photo set-up Appendix)



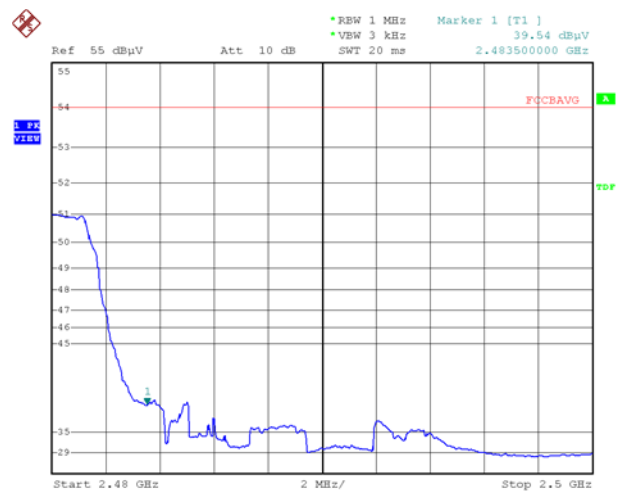
Peak Vertical Polarisation



Avg Vertical Polarisation



Peak Horizontal Polarisation



Avg Horizontal Polarisation

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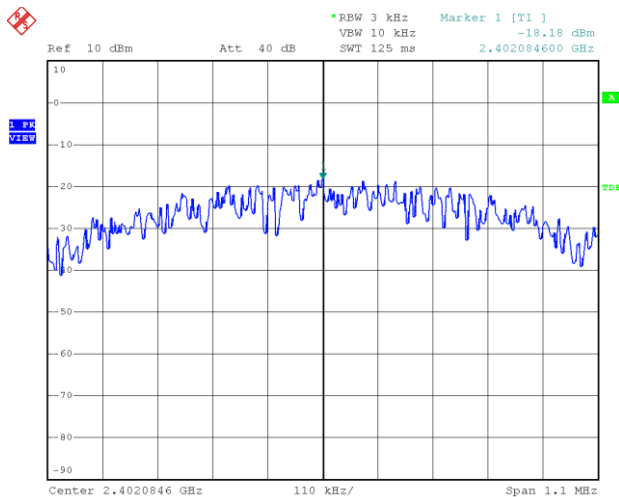


14 POWER SPECTRAL DENSITY, §15.247(e)

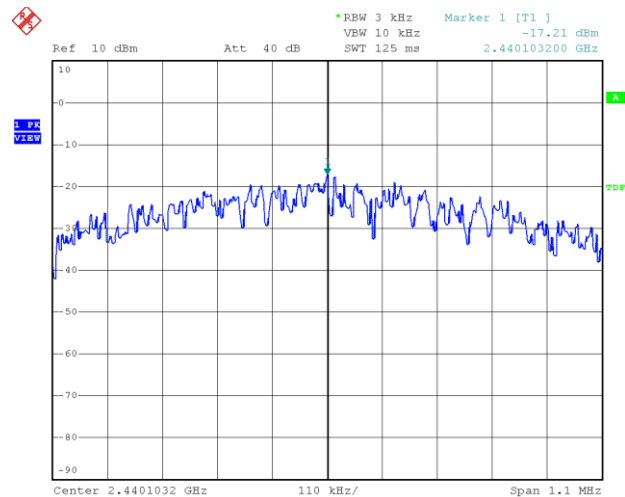
Measurements were performed on the sample with a temporary antenna port by applying the procedure detailed in ANSI C63.10, Clause 11.10.2 Method PKPSD (peak PSD).

The power was measured directly from the marker results, the cable and antenna loss used for the conducted measurements were compensated for.

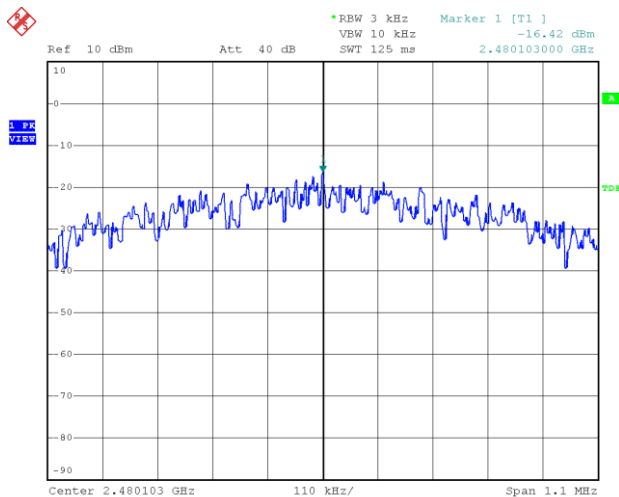
Channel	Peak Conducted PSD dBm/3 kHz	Limit dBm/3 kHz	Margin dB
0	-18.2	8	26.2
19	-17.2	8	25.2
39	-16.4	8	24.4



PSD – Ch 0



PSD – Ch 19



PSD – Ch 39

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15 MAXIMUM PERMISSIBLE EXPOSURE (MPE), §15.247(i)

The device was considered portable equipment as the transceiver could be used within 20 cm of a person. The following SAR exclusion calculation from KDB 447498 D01 was applied:

$$\left[\frac{(\text{Max. power, mW})}{(\text{min. separation, mm})} \right] \times [\sqrt{f_{\text{GHz}}}]$$
$$\leq 3.0 \text{ (for 1g SAR) and } \leq 7.5 \text{ (for 10g extremity SAR)}$$

Maximum conducted power, including tune up = 1 mW

Minimum separation distance = 5 mm

Operating frequency = 2.40 to 2.48 GHz

$$\left[\frac{(1 \text{ mW})}{(5 \text{ mm})} \right] \times [\sqrt{(2.48)}] = 0.3$$

Conclusion: The NUROCHEK-I Bluetooth transceiver complied with the maximum permissible exposure requirements at any separation distance without further measurement.

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