



RADIO TEST REPORT

FCC TITLE 47 PART 15C AND RSS-247 ISSUE 2

Client:	Minelab Electronics Pty Ltd	
Address:	2 Second Avenue, Mawson lakes, Adelaide, SA 5095, Australia	
Report Number:	0813COD_GPX6000_FCC15C-RSS247	
Date of Testing:	1 st May to 6 th August 2020	
File Number:	COD190708	
Equipment Name:	GPX6000 Metal Detector	
Model Number	GPX6000	
FCC ID:	Z4C-0039	
IC ID:	24927-0039	
Description:	Metal Detector	
Result:	COMPLIED	
Tested by	Steven Garnham Test Engineer	
Approved by:	Rob Weir Assessment Engineer	
Date of Issue:	13 August 2020	
<p>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.</p>		

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APPENDIX A – PHOTOGRAPHIC RECORD OF EUT

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APPENDIX C – EUT TEST SETUP PHOTOGRAPHS

APPENDIX D – FCC & IC LABEL & LOCATION

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1 REPORT REVISION HISTORY

Date	Report Number	Changes
29 Jun. 2020	0629COD_GRU_FCC15C-RSS247	Original report.
7 Aug. 2020	0807COD_GPX6000_FCC15C-RSS247	Revised in accordance with TCB requests.
10 Aug. 2020	0810COD_GPX6000_FCC15C-RSS247	Revised in accordance with TCB requests.
13 Aug. 2020	0813COD_GPX6000_FCC15C-RSS247	Revised in accordance with TCB requests.

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.

2.1 FCC 15C Summary

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)(1)	Channel Separation	Complied	-
15.247(a)(1)(iii)	Number of Hopping Channels	Complied	-
15.247(a)(1)(iii)	Time of Occupancy	Complied	-
15.247(b)(1)	Equivalent Peak Conducted Output Power	Complied	-
15.247(d)	Out of band emissions	Complied	-
15.247(i)	Maximum Permissible Exposure (MPE)	Complied	-
2.1049	99% Bandwidth	Noted	-

Notes:

- (i) Not applicable as the EUT was only powered by internal batteries, no direct or indirect AC mains connection.

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2.2 RSS-247 Summary

RSS-247 and RSS-Gen		Result	Notes
RSS-Gen (6.8)	Antenna Requirement	Complied	-
RSS-Gen (8.10)	Restricted Bands of Operation	Complied	-
RSS-Gen (8.8)	Conducted Limits	N.A.	(i)
RSS-Gen (8.9)	Radiated Emission Limits, General Requirements	Complied	-
RSS-247(5)	Standard specifications for frequency hopping systems and digital transmission systems operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz	Complied	-
RSS-247 (5.1)	Channel Separation	Complied	-
RSS-247 (5.1)	Number of Hopping Channels	Complied	-
RSS-247 (5.1)	Time of Occupancy	Complied	-
RSS-247 (5.4)	Peak Conducted Output Power	Complied	-
RSS-247 (5.5)	Out of band emissions	Complied	-
RSS-102	Maximum Permissible Exposure (MPE)	Complied	-
RSS-Gen (6.7)	99% Bandwidth	Noted	-

Notes:

- (ii) Not applicable as the EUT was only powered by internal batteries, no direct or indirect AC mains connection.

3 MODIFICATIONS

No modifications were required to achieve compliance.

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4 REFERENCES

FCC Title 47 Part 15 current as of June 2019
RSS-247 Issue 2: 2017
ANSI C63.10: 2013
KDB Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019
RSS-Gen Issue 5 with Amendment 1: 2019
RSS-102 Issue 5: 2015
Minelab GRU EMC Test Plan, project D40039; Rev. V1, 19/3/2020

5 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	GPX6000 Metal Detector
EUT Description:	Metal Detector
EUT Model:	GPX6000
EUT Serial Number:	Main Assy GRU4.3 Sample: #53489066954 User Interface / Display: # 62680969358 Search Coil GRU4-31: # 52875958648 Battery Pack: #22912959660
FCC ID:	Z4C-0039
IC ID:	24927-0039
Power Supply & Rating:	Battery Pack, Nominal – Labelled 7.2V / 5833mAh, Li-ion
Highest Frequency:	2480 MHz
Lowest Frequency:	4 kHz
Frequency Range:	2402 MHz to 2480 MHz
Transmit Power:	0.5 mW
Modulation Technique:	BT: GFSK, 4-DQPSK, 8-DPSK
Number of Channels:	79 Channels
Antenna Specifications:	Maximum gain: 3.3 dBi; Internal Antenna size 25.7 x 7.5 mm

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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.

Measurements were performed using the radiated method on the supplied sample. It was a modified unit with an interface ribbon cable installed for programming.

Control software used was BlueTest3 installed on the client’s supplied laptop.

To enable control of the BT transmission, the EUT was connected to the following items:

- a. A supplied test HP laptop PC with HP power adaptor.
- b. Interface board, DEV-PC-1.
- c. Ethernet to USB adaptor, CSR USB-SP1, 1324 Converter.
- d. Using instructions provided by the client for the BlueTest3 software, constant BT transmission on selected low, middle and high channels was made. Output power indication on the software was set to 0dBm as per manufacturer’s instructions. Frequency hopping mode with modulation could also be selected.

The EUT was operated within its allowed temperature and humidity range.

There were no facilities for charging the battery pack while installed in the EUT. For charging purposes, the battery pack was removed and connected to the supplied charger adapter.

The test PC (via AC adapter) was connected to the 115VAC 60Hz mains supply, provided by the AC source. There was no mains connection to the EUT.

6.1 EUT Operating Modes

Mode No.	Operating Mode Description
1	Constant BT transmission with modulation (both EDR and BDR); o/p power setting 0dBm, on Ch0 (2402MHz).
2	Constant BT transmission with modulation (both EDR and BDR); o/p power setting 0dBm on Ch39 (2441MHz).
3	Constant BT transmission with modulation (both EDR and BDR); o/p power setting 0dBm on Ch78 (2480MHz).
4	Constant Frequency Hopping with modulation

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7 TEST SPECIFICATIONS

7.1 Test Facility

Testing was performed at Austest Laboratories, 46 Glenola Farm Lane, Yarramalong, NSW 2259, Australia.

Radiated emission testing below 1GHz and was performed at an Open Area Test Site (OATS) at Yarramalong, where some ambient signals may exceed the limit. The possibility of missing an emission during testing is removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements.

For testing below 30MHz, measurements were performed over the normal OATS ground plane and also over a non-conductive ground plane as per ANSI C63.10, clause 5.2.

7.2 Accreditations and Listings

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 ISED under the ACMA-ISED APEC-TEL MRA. Designation Number AU0003 / Registration number 520620.

Austest Laboratories (NSW)'s Castle Hill and Yarramalong test facilities are accredited by A2LA. The tests reported herein have been performed in accordance with its terms of accreditation.

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, $k=2$.

Test	Measurement Uncertainty
RF Frequency	± 5 part in 10^{10}
RF power conducted	± 1.3 dB
RF power radiated <1GHz	± 4.5 dB
RF power radiated >1GHz	± 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	

All test equipment was checked and performance verified prior to testing.

8 ANTENNA REQUIREMENT

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

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 and RSS-Gen 8.9.

10 CONDUCTED LIMITS

Not applicable as the EUT was only powered from a battery pack. The battery had to be removed from the EUT for recharging.

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11 RADIATED SPURIOUS EMISSIONS

Test Dates: 20 May 2020 Temperature: 22°C Humidity: 48%
 28 May 2020 27°C 24%
 03 August 2020 19°C 57%

Test Officer: Steven Garnham
 Test Location: Austest Laboratories (Yarramalong)

11.1 EUT Operating Mode

- Battery voltage – 7.8VDC.
- Mode 1 – Constant BT transmission with modulation, ch0.
- Mode 2 – Constant BT transmission with modulation, ch39.
- Mode 3 – Constant BT transmission with modulation, ch78.
- Frequency Hopping with modulation.

Preliminary measurements with the EUT oriented in 3 orthogonal axis were made to determine the orientation of the EUT that would generate the highest emission levels. Final measurement was made with the EUT in a diagonal position at approximately 45 deg. using the supplied PVC pipe stand which simulated a normal user orientation.

The preliminary measurements also including comparing the BDR and EDR modes. No noticeable differences detected to spurious emission, EDR mode selected for full testing.

11.2 Test Method

- Measurements were performed in accordance with ANSI C63.10-2013, KDB 558074 FHSS Meas Guidance. Average measurements were made with an average detector, video averaging was not employed.
- The measuring receiver BW settings were:

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	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 Average	Average	1 MHz	3 MHz
		Final Peak	Peak	1 MHz	3 MHz
		Final Average	Average	1 MHz	3 MHz

- The EUT was setup on a non-conductive turntable.
- For measurement below 1GHz at a height of 0.8m above the OATS conductive ground plane and at the indicated test distance away from the measuring antenna.

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- e. For measurements above 1GHz at a height of 1.5m above the OATS conductive ground plane with RF absorber placed between the test table and measuring antenna.
- f. To maximise emissions, the EUT was rotated through 360° and the measuring antenna height adjusted between 1m to 4m in the following antenna orientations:
 - i. Loop antenna (9kHz to 30MHz) – Coaxial, coplanar orientations and also horizontal (parallel to ground) orientations were investigated as the EUT antenna can have both vertical and horizontal positions.
 - ii. Bilog antenna (30MHz to 1GHz) - Both vertical and horizontal polarizations.
 - iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- g. The maximised emission level was measured and the above repeated for all measurement frequencies.
- h. Average level measurements were not made where the peak level did not exceed the average limit.
- i. Linearity of the measuring system was checked, reducing gain when required.
- j. Test distances: Where the actual test distance used was different to that specified, then the test data results shown in any tables were extrapolated to the required distance using the formula specified within ANSI C63.10:2013. For simplicity, the test data plots have the limit lines adjusted to reflect any different test distance giving a visual indication of the relative margins.
- k. **Ambient Emissions:** Measurements were performed at an Open Area Test Site (OATS), where some ambient signals may exceed the limit. The possibility of missing an emission during testing was removed by performing pre-scans in a shielded enclosure prior to the final OATS measurements. The ambient emissions are indicated as a '1' or 'A' on the scans, refer to the notes after the graphs.

11.3 Sample Calculation Example

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

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

- E = Radiated Electric Field Strength in dBμV/m at the specified distance.
- V = EMI Receiver measured signal input voltage in dBμV.
- AF = Antenna Factor of the measuring antenna in dB/m.
- L_{cbl} = Total cable insertion loss in dB.
- G_{pre} = Pre-amplifier gain in dB.

Frequency (MHz)	Receiver Level, V (dBμV)	AF (dB/m)	Lcbl (dB)	Gpre (dB)	Corrected Level, E (dBμV/m)
100.0	40.0	12.0	2.9	22.5	32.4

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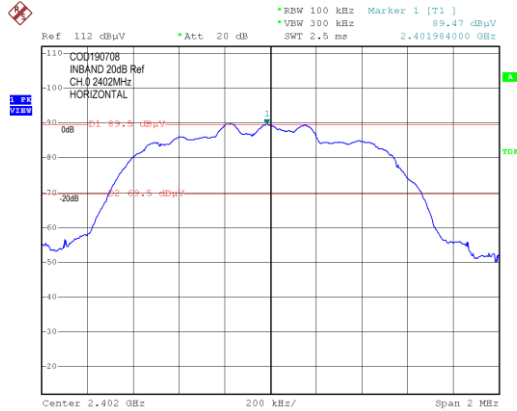
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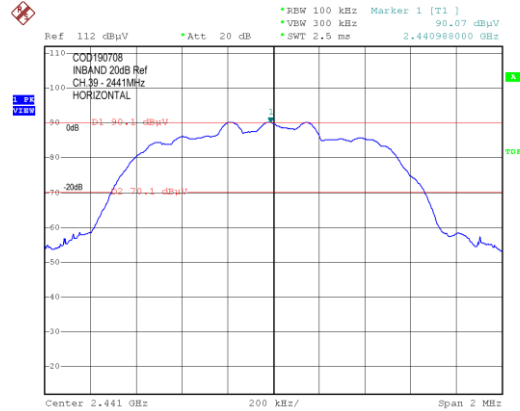
11.4 Reference in-band levels

The following measurements were made with a 100 kHz RBW to determine the limit for emissions in the non-restricted bands. For simplicity the FCC 15.209 and RSS-Gen 8.9 limits these were applied over the required range as they were lower.



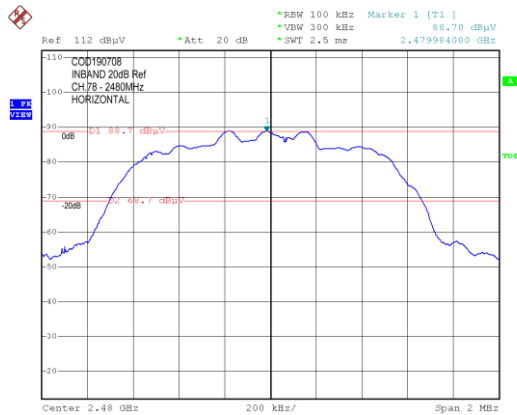
Date: 3.AUG.2020 10:48:44

Highest Radiated In-band – Ch0



Date: 3.AUG.2020 11:31:31

Highest Radiated In-band – Ch39



Date: 3.AUG.2020 11:02:02

Highest Radiated In-band – Ch78

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11.5 Test Results

Frequency range: 9 kHz to 25 GHz.

All measured out of band emission levels were below the 15.209/RSS-Gen 8.9 limits and greater than 20 dB below the highest level of the desired power measured within a 100 kHz bandwidth.

9 kHz to 30 MHz, all intentional radiation was greater than 20 dB below the limits specified in section FCC15.209 and RSS-Gen 8.9.

The 6 highest EUT spurious emissions 30 MHz to 1 GHz are tabulated below:

Frequency MHz	Channel	Antenna Pol.	QP Level (dB μ V/m)	QP Limit (dB μ V/m)	QP Pass Margin (dB)
74.7	All	Vertical	33.5	40.0	6.5
77.5	All	Vertical	32.8	40.0	7.2
72.9	All	Horizontal	32.7	40.0	7.3
60.5	All	Vertical	32.5	40.0	7.5
32.2	All	Vertical	32.1	40.0	7.9
56.3	All	Vertical	32.0	40.0	8.0

The 6 highest EUT spurious emissions above 1 GHz are tabulated below:

Frequency MHz	Channel Number	Antenna Pol.	Pk Level dB μ V/m	Pk Limit dB μ V/m	Margin dB	Avg Level dB μ V/m	Avg Limit dB μ V/m	Margin dB
4960	78	Horizontal	57.1	74.0	16.9	50.2	54.0	3.8
4882	39	Vertical	53.2	74.0	>20	49.9	54.0	4.1
4882	39	Horizontal	57.0	74.0	17.0	48.8	54.0	5.2
4960	78	Vertical	51.8	74.0	>20	47.5	54.0	6.5
4804	0	Horizontal	52.7	74.0	>20	45.9	54.0	8.1
4804	0	Vertical	50.1	74.0	>20	45.6	54.0	8.4

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11.5.1 Radiated Disturbances: 9kHz to 150kHz at 10m 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.

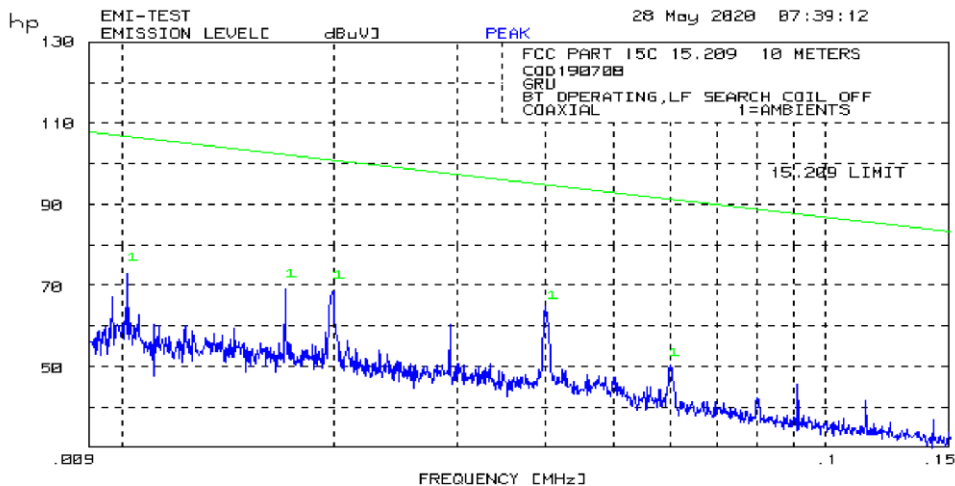
Where 15.9MHz calculated as the near field point for 3 meter measurements.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X KHz resulted in a level of Y dBuV/m, which is equivalent to $Y - 51.5 = Z$ dBuA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

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.



Maximum emissions

Note: A Green '1' indicates an ambient emission.

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11.5.2 Radiated Disturbances: 150kHz to 30MHz at 3m 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.

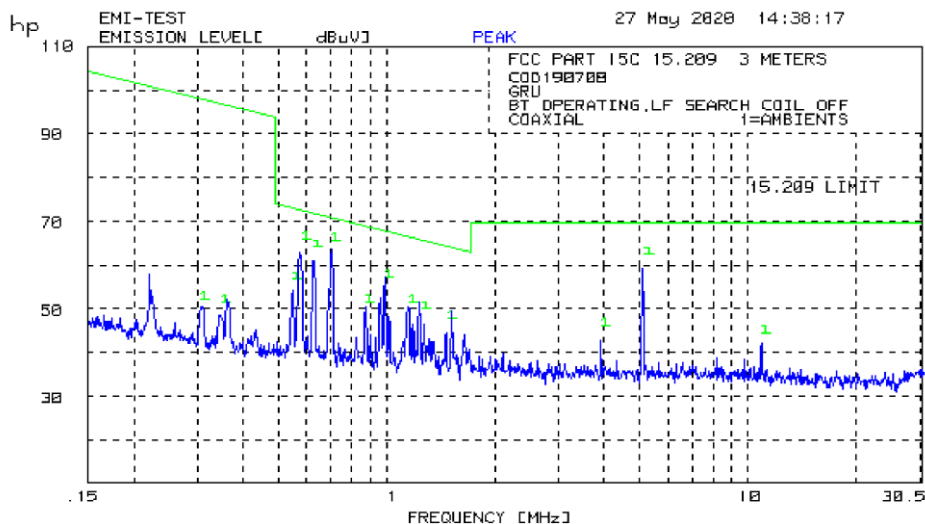
Where 15.9MHz calculated as the near field point for 3 meter measurements.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω. For example, the measurement frequency X KHz resulted in a level of Y dBuV/m, which is equivalent to $Y-51.5 = Z$ dBuA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to the 15.209(a) limit.

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



Maximum emissions

Note: A Green '1' indicates an ambient emission.

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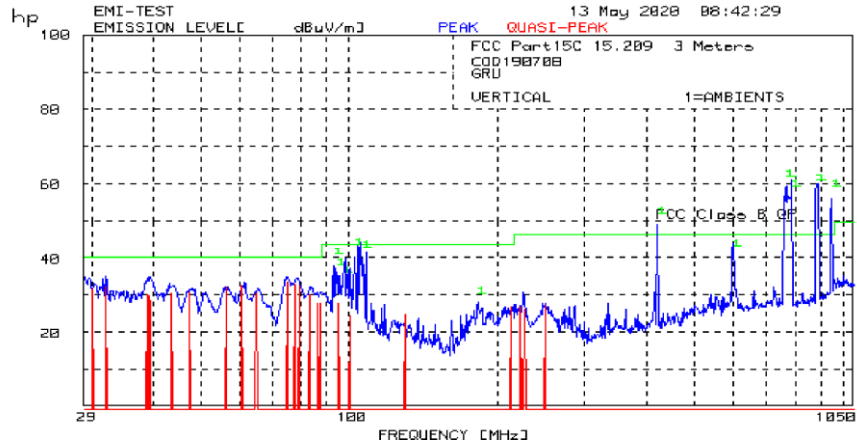
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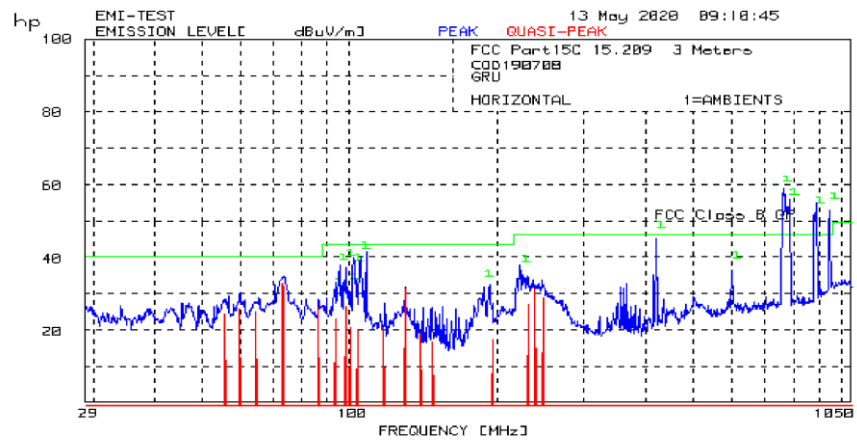
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11.5.3 Radiated Disturbances: 30MHz to 1000MHz at 3m distance



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz - Horizontal)

Note: A Green '1' indicates an ambient emission.

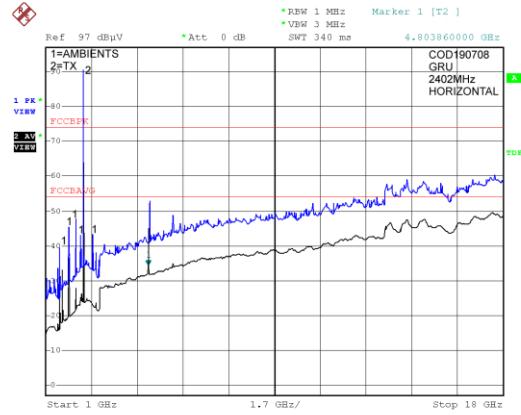
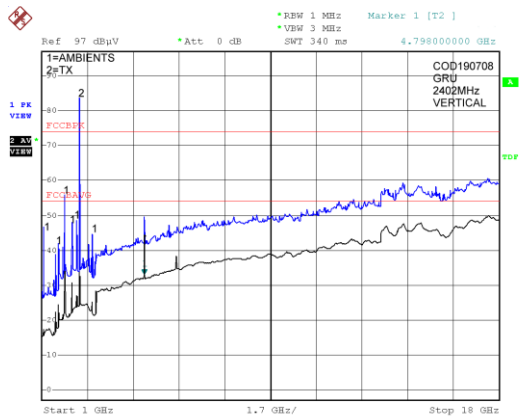
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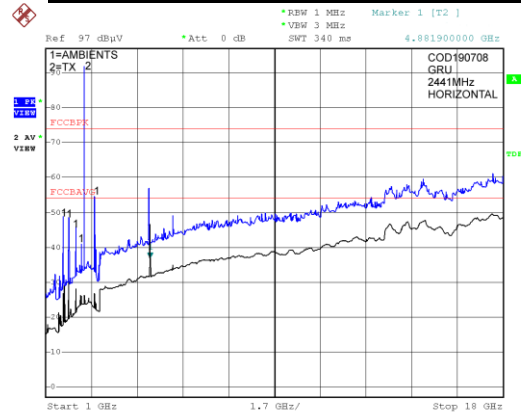
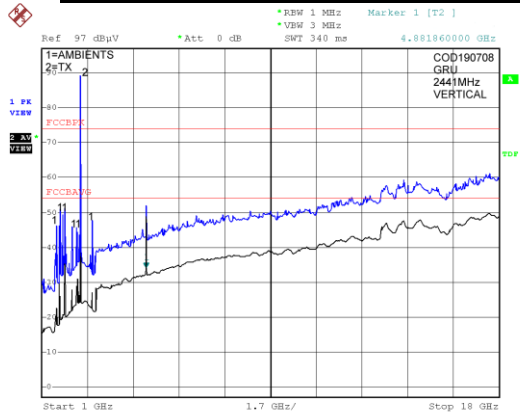


11.5.4 Radiated Disturbances: 1 GHz to 18 GHz at 3m distance



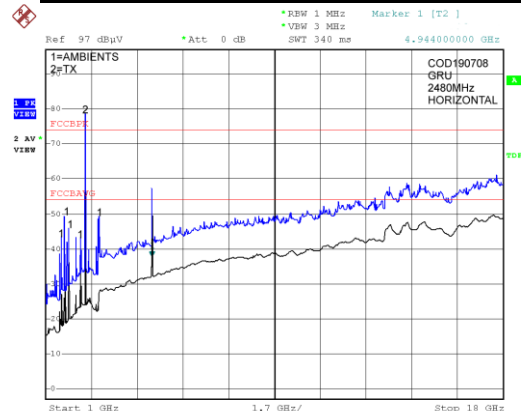
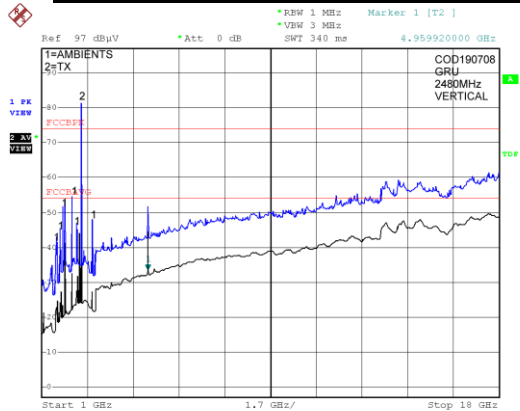
Ch0 – Peak / Avg Vertical Polarisation

Ch0 – Peak / Avg Horizontal Polarisation



Ch39 – Peak / Avg Vertical Polarisation

Ch39 – Peak / Avg Horizontal Polarisation



Ch78 – Peak / Avg Vertical Polarisation

Ch78 – Peak / Avg Horizontal Polarisation

Note: A '1' indicates an ambient emission.
 Note: A '2' indicates an intentional transmitter emission.

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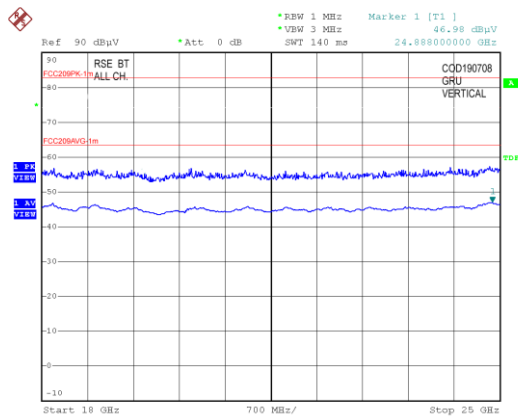


11.5.5 Radiated Disturbances: 18GHz to 25GHz at 1m distance

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.

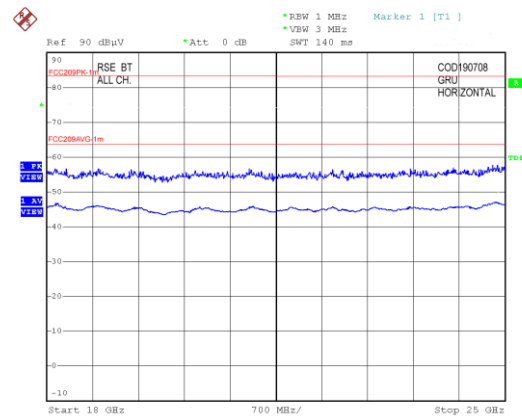
All intentional radiation spurious were greater than 10dB below the limits specified in FCC 15.209 and RSS-Gen. Emission levels were not affected by RF channel selection.

Following plots indicate limits calculated for a 1m distance.



Date: 14.MAY.2020 07:57:45

Peak / Avg Vertical Polarisation



Date: 14.MAY.2020

Peak / Avg Horizontal Polarisation

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11.6 Band edge measurements

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

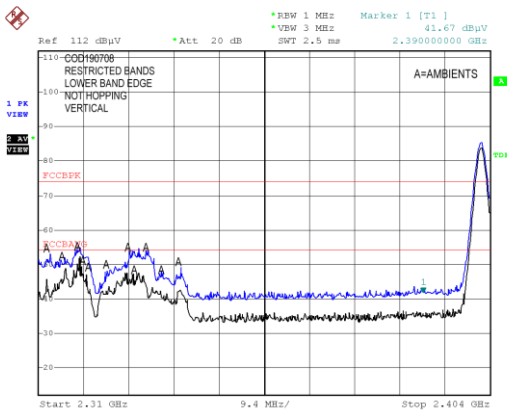
All measured disturbance levels were greater than 20dB below the FCC15.209 and RSS-Gen Peak limits.

The highest measured Average disturbance level was 17.3 dB below the FCC15.209 and RSS-Gen Average limit.

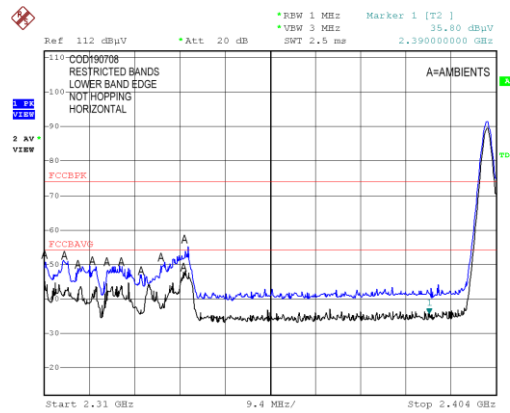
Both hopping and not hopping modes assessed.

Note: An 'A' on the plot, indicates an ambient emission.

Not hopping mode using channel 0, constant transmission:



Date: 3.AUG.2020 10:01:39

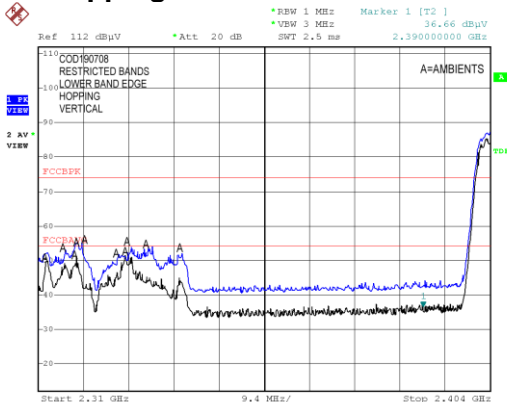


Date: 3.AUG.2020 10:11:01

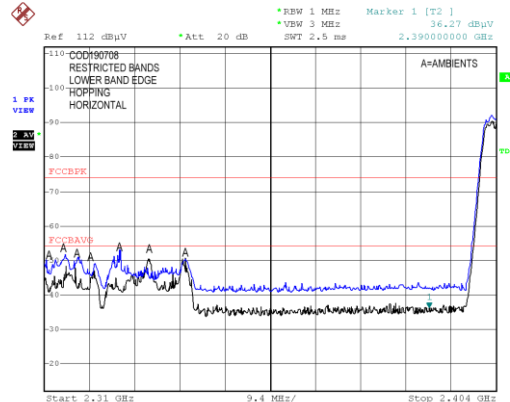
Ch0 – Peak/Average Vertical Polarisation

Ch0 – Peak/Avg Horizontal Polarisation

Hopping mode:



Date: 3.AUG.2020 10:06:01



Date: 3.AUG.2020 10:18:11

Peak/Average Vertical Polarisation

Peak/Avg Horizontal Polarisation

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

The highest measured Peak disturbance was 18.3 dB below the FCC15.209 and RSS-Gen Peak limit.

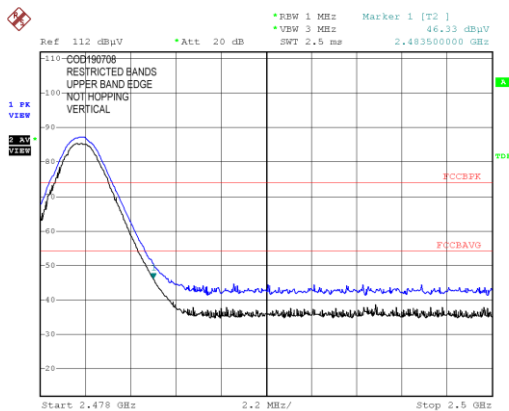
The highest measured Average disturbance was 2.6 dB below the FCC15.209 and RSS-Gen Average limit.

Frequency MHz	Channel Number	Antenna Pol.	Pk Level dB μ V/m	Pk Limit dB μ V/m	Margin dB	Avg Level dB μ V/m	Avg Limit dB μ V/m	Margin dB
2483.5	Not Hopping	Horizontal	55.7	74.0	18.3	51.4	54.0	*2.6
2483.5	Hopping	Horizontal	54.4	74.0	19.6	51.4	54.0	*2.6
2483.5	Not Hopping	Vertical	50.5	74.0	>20	46.3	54.0	7.7
2483.5	Hopping	Vertical	49.6	74.0	>20	45.6	54.0	8.8

*Results were within the laboratory's measurement uncertainty.

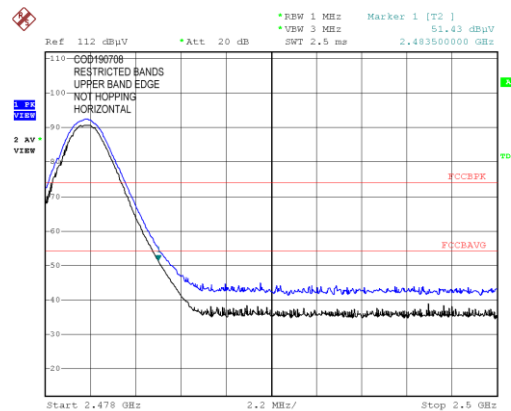
Both hopping and not hopping modes assessed.

Not hopping mode using channel 78, constant transmission:



Date: 3.AUG.2020 09:52:26

Ch78 – Peak/Avg Vertical Polarisation



Date: 3.AUG.2020 09:39:08

Ch78 – Peak/Avg Horizontal Polarisation

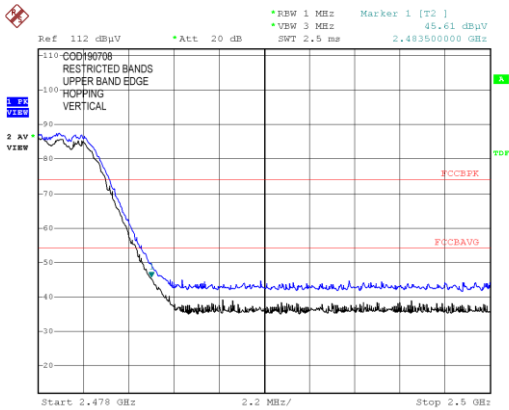
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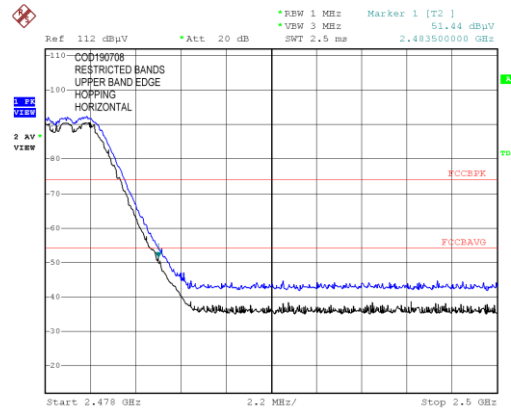


Hopping mode:



Date: 3.AUG.2020 09:56:05

Peak/Avg Vertical Polarisation



Date: 3.AUG.2020 09:45:11

Peak/Avg Horizontal Polarisation

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12 Channel Separation, Hopping Channels and Time of Occupancy

Test Dates:	20 May 2020 03 June 2020	Temperature:	22°C 20°C	Humidity:	48% 58%
Test Officer:	Steven Garnham				
Test Location:	Austest Laboratories (Yarramalong)				

12.1 EUT Operating Mode

- Battery voltage – 7.8VDC. (Fully charged=8.1VDC), Nominal 7.2VDC on label.
- Mode 1 – Constant BT transmission, ch0.
- Mode 2 – Constant BT transmission, ch39.
- Mode 3 – Constant BT transmission, ch78.

12.2 Test Method

Measurements were made using the supplied modified EUT fitted with an interface board with laptop to control the BT function. The normal internal antenna was used as supplied.

- Measurements were performed in accordance with ANSI C63.10-2013 and KDB 558074 FHSS Measurement Guidance.
- The EUT was measured via the radiated method.
- Measurements were repeated for the low, middle and high channels across all transmit modes.

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12.3 Channel Separation

12.3.1 -20dB Bandwidth – BDR / EDR

Channel / Frequency MHz	Modulation Mode	20dB Bandwidth (MHz)
0 - (2402)	GFSK / 1Mbps	0.852
39 – (2441)	GFSK / 1Mbps	0.852
78 – (2480)	GFSK / 1Mbps	0.852
0 - (2402)	8DPSK / 3Mbps	1.278
39 – (2441)	8DPSK / 3Mbps	1.272
78 – (2480)	8DPSK / 3Mbps	1.272

BDR-GFSK 1Mbps

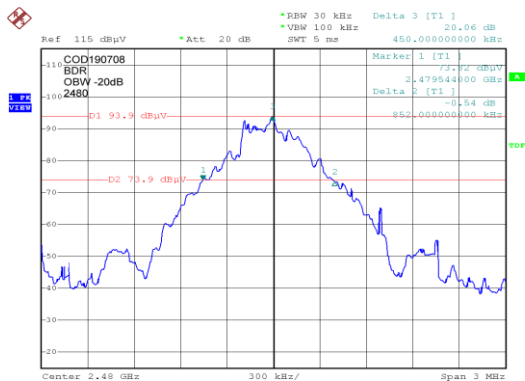


Date: 23.JUN.2020 13:00:52



Date: 23.JUN.2020 14:33:34

20dB Bandwidth- Ch0



Date: 23.JUN.2020 15:01:52

20dB Bandwidth- Ch78

20dB Bandwidth- Ch39

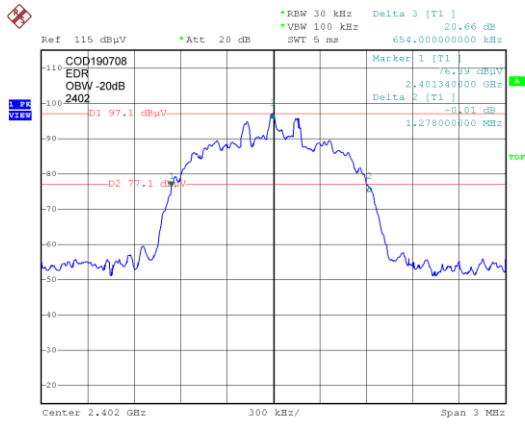
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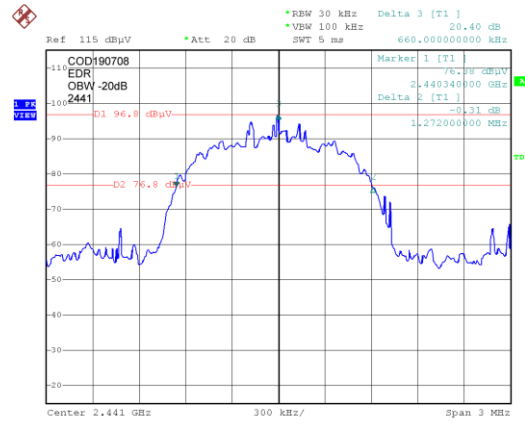


EDR – 8DPSK 3Mbps



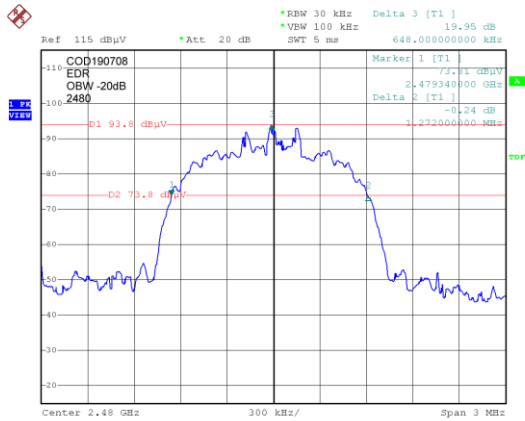
Date: 23.JUN.2020 14:41:15

20dB Bandwidth – Ch0



Date: 23.JUN.2020 13:50:18

20dB Bandwidth – Ch39



Date: 23.JUN.2020 15:18:19

20dB Bandwidth – Ch78

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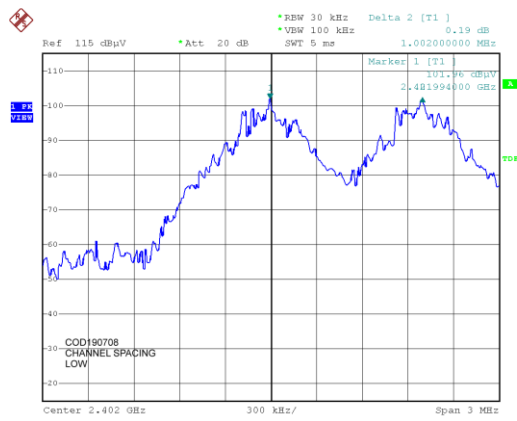
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12.3.2 Channel Separation

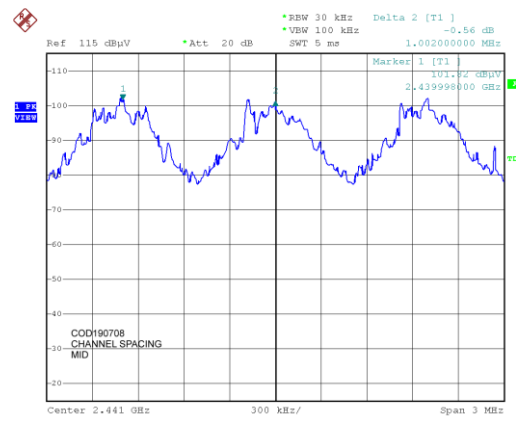
Channel / Frequency MHz	Measured Separation (kHz)	20dB Bandwidth (kHz)	2/3 of 20dB Bandwidth Limit (kHz)
0 - (2402)	1002	852	568
39 - (2441)	1002	852	568
78 - (2480)	1002	852	568

The minimum separation measured was 1.002 MHz and complied with the minimum limit of 0.568 MHz.



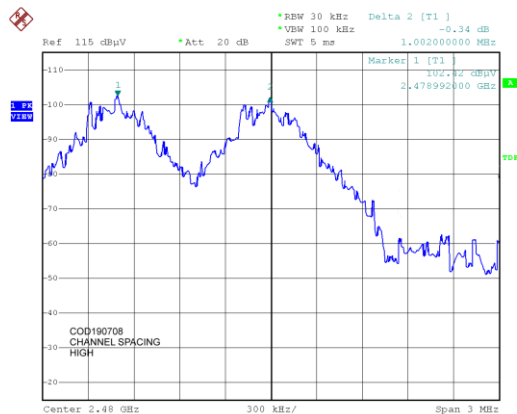
Date: 17.JUN.2020 13:50:53

Channel Spacing – Ch0



Date: 17.JUN.2020 13:56:37

Channel Spacing – Ch39



Date: 17.JUN.2020 14:06:58

Channel Spacing – Ch78

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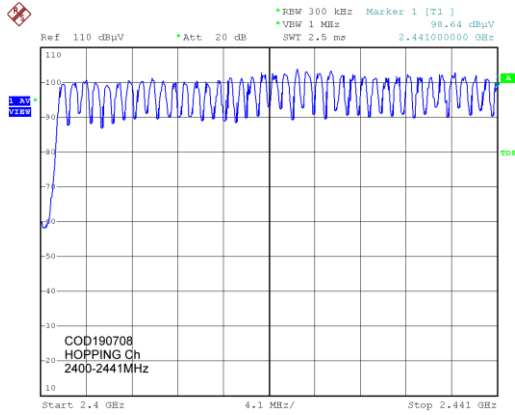
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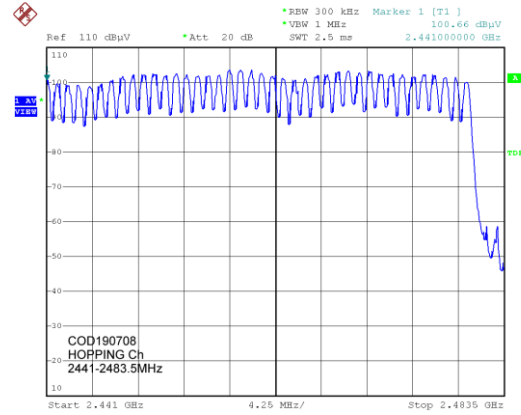
12.4 Number of Hopping Channels

A total of 79 channels were used, the limit was >15.



Date: 14.MAY.2020 13:52:13

2400 – 2441MHz



Date: 14.MAY.2020 14:42:53

2441 – 2483.5MHz

The transceiver employs Adaptive Frequency Hopping (AFH), identifying sources of interference and excluding them from the list of available channels. The process of re-mapping reduces the number of available channels from 79 to a minimum of 20.

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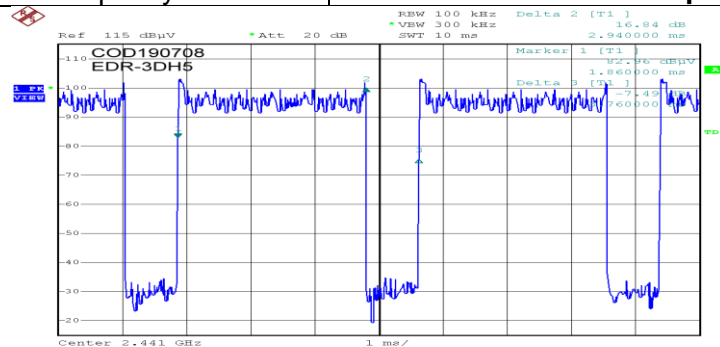


12.5 Time of Occupancy

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

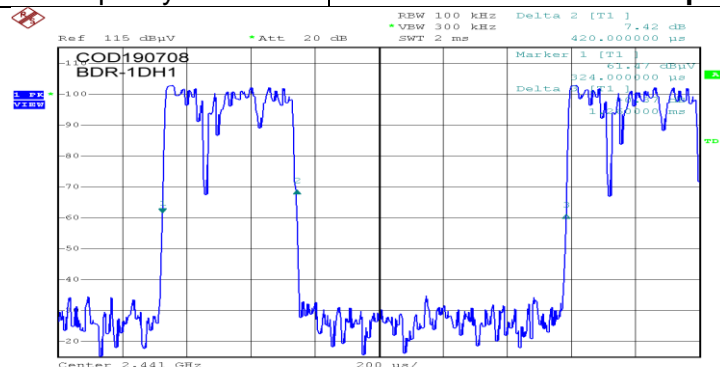
EDR / 3DH5 mode (longest transmit time):

Limit	0.4 seconds in any 31.6 s.
Tx(ON)	2.94ms
Transmission period	3.76ms
Channels per hopping sequence	79
Time for one hopping sequence	3.76 x 79 = 297.0ms
Hops on one channel in 31.6 s	31.6/0.297 = 106.4
Average time of Occupancy	106.4 x 0.00294 = 0.313s per 31.6



BDR / 1DH1 mode (shortest transmit time):

Limit	0.4 seconds in any 31.6 s.
Tx(ON)	0.420ms
Transmission period	1.260ms
Channels per hopping sequence	79
Time for one hopping sequence	1.26 x 79 = 99.5ms
Hops on one channel in 31.6 s	31.6 / 0.0995 = 317.6
Average time of Occupancy	317.6 x 0.00042 = 0.133s per 31.6



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13 PEAK CONDUCTED OUTPUT POWER

Test Date: 31st July 2020
Test Officer: Steven Garnham
Test Location: Austest Laboratories (Yarramalong)

Temperature: 20°C, 18°C
Humidity: 61%, 82%

13.1 EUT Operating Mode

- a. Battery voltage – 7.9VDC.
- b. Mode 1 – Constant BT transmission, EDR and BDR modes, ch0.
- c. Mode 2 – Constant BT transmission, EDR and BDR modes, ch39.
- d. Mode 3 – Constant BT transmission, EDR and BDR modes, ch78.

13.2 Test Method

Measurements were made using the supplied modified EUT fitted with an interface board with laptop to control the BT function. The normal internal antenna was used as supplied.

- a. Measurements were performed in accordance with ANSI C63.10-2013 and KDB 558074 FHSS Meas Guidance.
- b. The EUT was measured via the radiated method then converted to a conducted output using the EUT's internal antenna gain.
- c. Recorded levels were then converted to an equivalent conducted antenna port levels by using the antenna gain in accordance with KDB558074 Clause 3. The following equation was applied to convert the measured field in dBµV/m to radiated power in dBm.

$$P = E - 20 \log \left(\frac{\sqrt{30}}{d} \right) - 90$$

Where E = Electric field strength, in dBµV/m
 P = Radiated power, in dBm
 d = Measurement distance, in metres

- a. Spectrum analyser settings were 3MHz RBW, VBW 3MHz.
- b. The emission was maximum and the reading was recorded.
- c. Measurements were repeated for the low, middle and high channels and across all transmit modes.

13.3 Directional antenna gain

Not applicable as the gain was less than 6 dBi.

13.4 Transmit Power – Supply Voltage Variation

The EUT was powered from a fully charged battery pack. The EUT was tested using a charged Li-ion battery pack with the total measured supply being 7.9 VDC.

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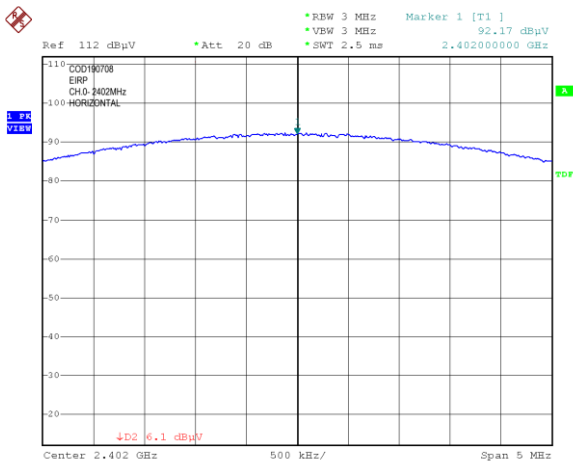
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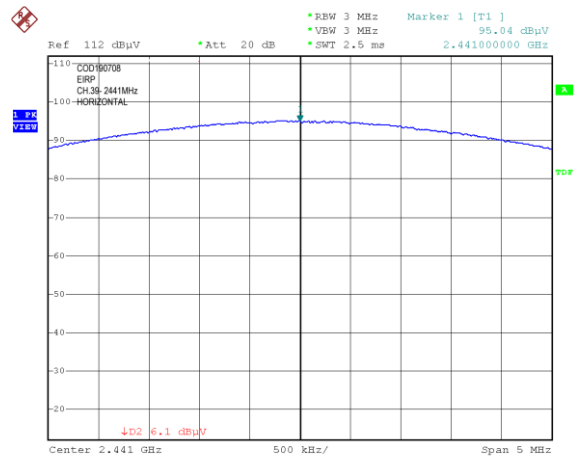


13.5 Test Results: EDR

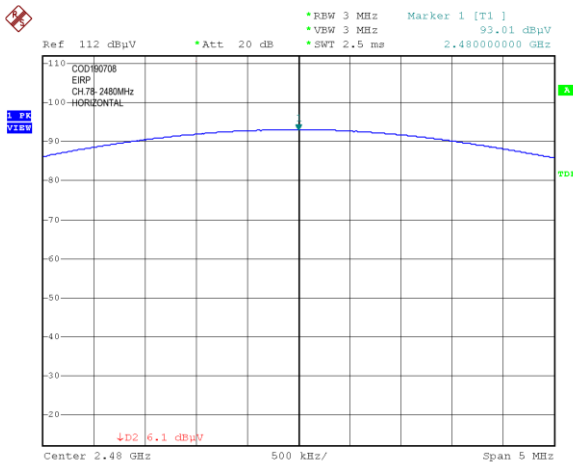
Channel	Radiated EIRP Level		Equiv. Conducted Output Power			Limit		Margin
	dBµV/m @ 3m	dBm	Ant. gain	dBm	mW	dBm	mW	
0	92.17	-3.1	3.3dBi	-6.4	0.23	21	125	27.4
39	95.04	-0.2	3.3dBi	-3.5	0.45	21	125	24.5
78	93.01	-2.2	3.3dBi	-5.5	0.28	21	125	26.5



Radiated Power – Ch0



Radiated Power – Ch39



Radiated Power – Ch78

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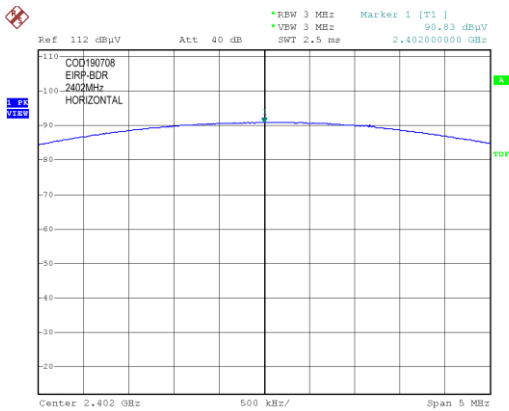
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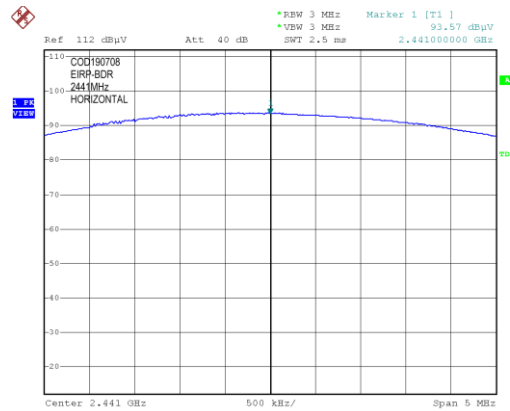
13.6 Test Results: BDR

Channel	Radiated EIRP Level		Equiv. Conducted Output Power			Limit		Margin
	dBµV/m @ 3m	dBm	Ant. gain	dBm	mW	dBm	mW	
0	90.83	-4.4	3.3dBi	-7.7	0.17	21	125	28.7
39	93.57	-1.7	3.3dBi	-5.0	0.32	21	125	26.0
78	91.33	-3.9	3.3dBi	-7.2	0.19	21	125	28.2



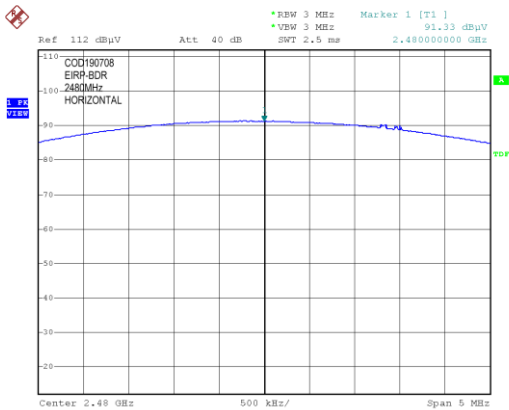
Date: 10.AUG.2020 08:49:45

Radiated Power – Ch0



Date: 10.AUG.2020 08:45:04

Radiated Power – Ch39



Date: 10.AUG.2020 08:38:27

Radiated Power – Ch78

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14 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

14.1 FCC Section 15.247(i)

The device was considered portable equipment as the transceiver could be used within 20 cm. The following SAR exclusion calculation was applied:

$$\left[\frac{(\text{Max. power, mW})}{(\text{min. separation, mm})} \right] \times [\sqrt{f_{\text{GHz}}}]$$

≤ 3.0 (for 1g SAR) and ≤ 7.5 (for 10g extremity SAR)

As measured the maximum power was 0.5 mW, and therefore:

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

The GPX6000 Bluetooth transceiver complied with the maximum permissible exposure requirements at any separation distance without further measurement.

14.2 RSS-102

The device was considered portable equipment as the transceiver could be used within 20 cm of a person.

Due to the location of the antenna within the device it would not be closer than 50 mm from a user in normal operation when they are holding it by the handle or pressing the buttons. The antenna location was above the display and away from the handle.

From table 1 in RSS-102 Clause 2.5.1 the maximum allowed power for SAR exemption is 309 mW. As the maximum power measured was 0.5 mW the GPX6000 Bluetooth transceiver complied with the maximum permissible exposure requirements without further measurement.

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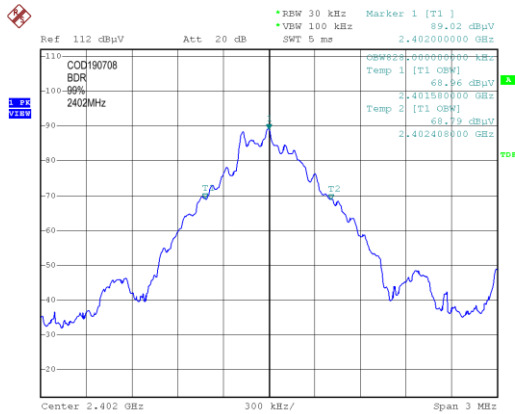
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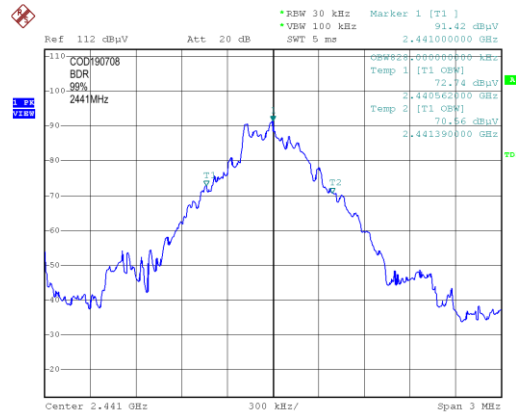
15 99% BANDWIDTH

Channel	Modulation	99% Bandwidth (kHz)
0 - (2402)	GFSK / 1Mbps	828.0
39 - (2441)	GFSK / 1Mbps	828.0
78 - (2480)	GFSK / 1Mbps	834.0
0 - (2402)	8DPSK / 3Mbps	1152.0
39 - (2441)	8DPSK / 3Mbps	1170.0
78 - (2480)	8DPSK / 3Mbps	1158.0



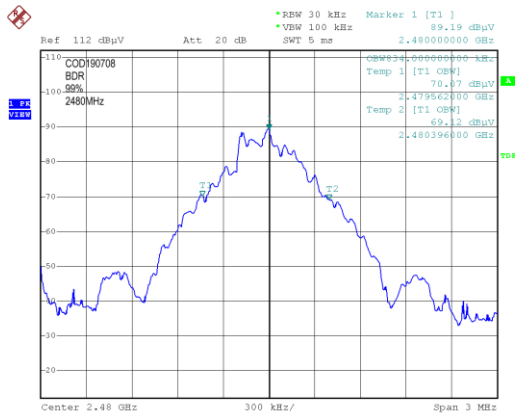
Date: 10.AUG.2020 08:57:46

BDR - 99% Bandwidth – Ch0



Date: 10.AUG.2020 09:07:29

BDR - 99% Bandwidth – Ch39



Date: 10.AUG.2020 09:56:30

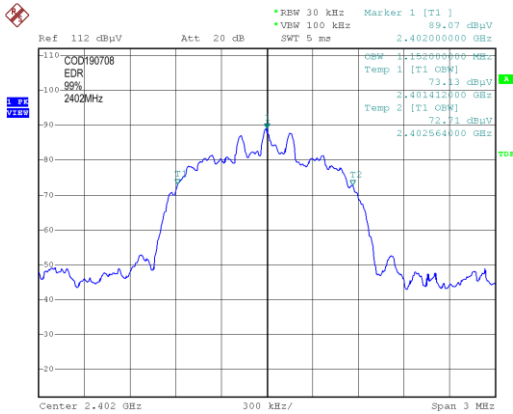
BDR - 99% Bandwidth – Ch78

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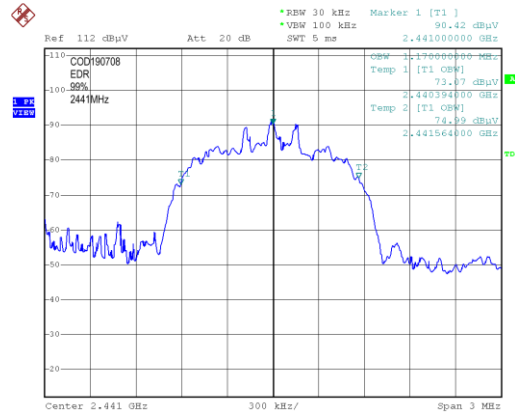
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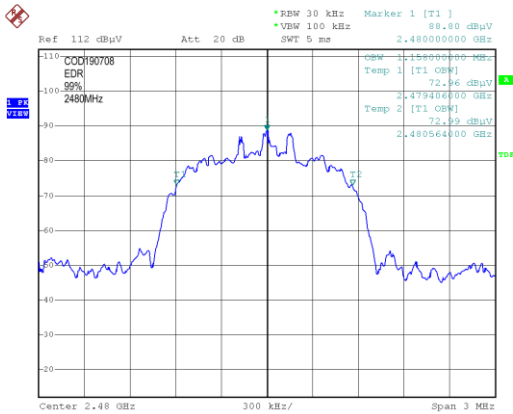
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