

## 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 <sup>st</sup> May to 6 <sup>th</sup> 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:                                                                                                                                                                                        | <b>COMPLIED</b>                                             |                                                                                      |  |
| Tested by                                                                                                                                                                                      | Steven Garnham<br>Test Engineer                             |  |  |
| Approved by:                                                                                                                                                                                   | Rob Weir<br>Assessment Engineer                             |  |  |
| Date of Issue:                                                                                                                                                                                 | 13 August 2020                                              |                                                                                      |  |
| <p>Results appearing herein relate only to the sample(s) tested.</p> <p>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

APPENDIX B – INTERNAL VIEW OF EUT

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<br>User Interface / Display: # 62680969358<br>Search Coil GRU4-31: # 52875958648<br>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 supplied test HP laptop PC with HP power adaptor.
- Interface board, DEV-PC-1.
- Ethernet to USB adaptor, CSR USB-SP1, 1324 Converter.
- 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            | $\pm 5$ part in $10^{10}$ |
| RF power conducted      | $\pm 1.3\text{dB}$        |
| RF power radiated <1GHz | $\pm 4.5\text{dB}$        |
| RF power radiated >1GHz | $\pm 4.9\text{dB}$        |

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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<sub>cbl</sub> = Total cable insertion loss in dB.  
 G<sub>pre</sub> = Preamplifier 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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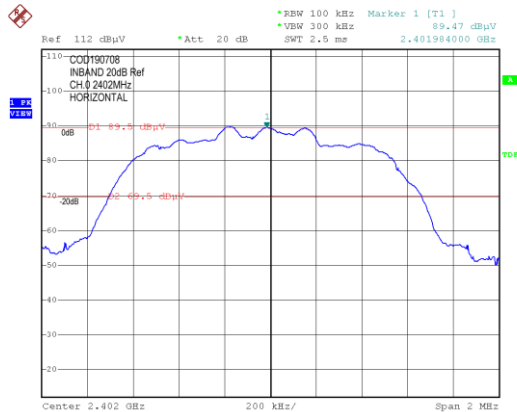
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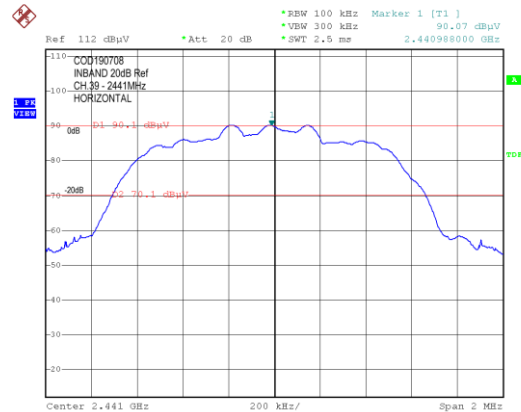
## 11.4 Reference in-band levels

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.



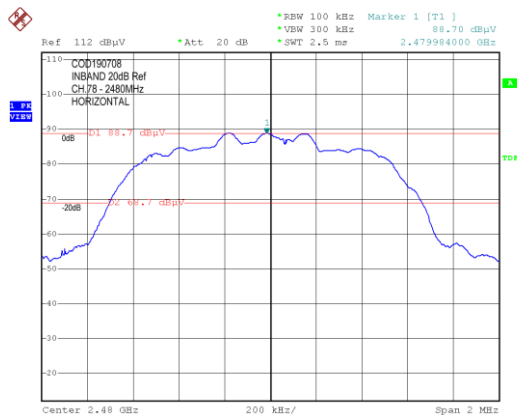
Date: 3.AUG.2020 10:48:44

### 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 (dBμV/m) | QP Limit (dBμV/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 dBμV/m | Pk Limit dBμV/m | Margin dB | Avg Level dBμV/m | Avg Limit dBμV/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.

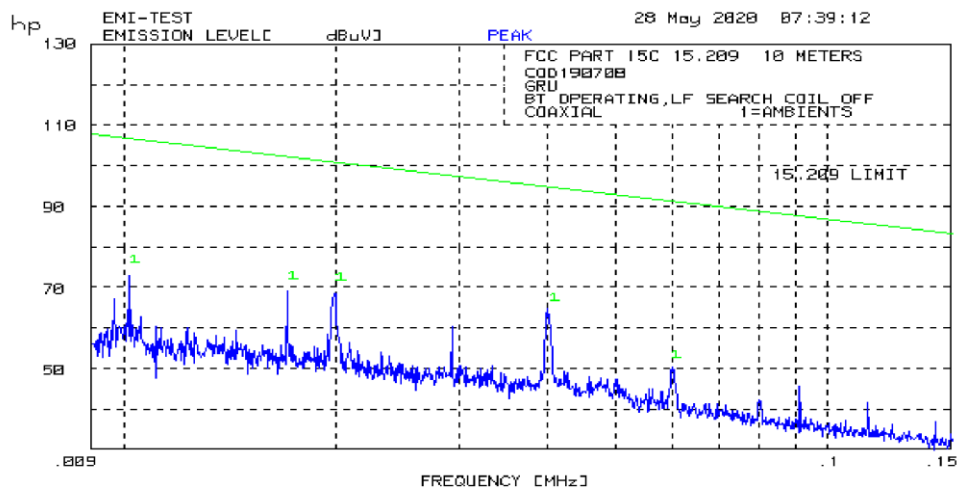
Where 15.9MHz calculated as the near field point for 3 meter measurements.

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.

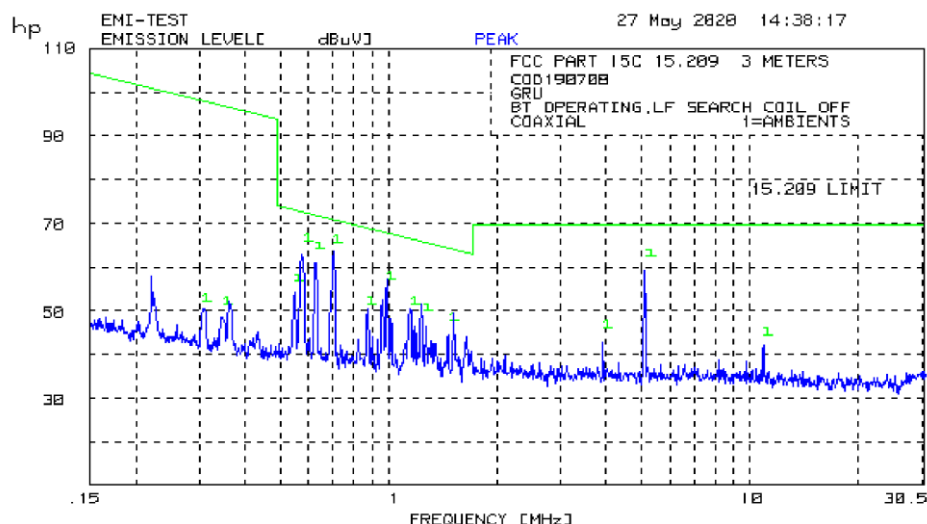
Where 15.9MHz calculated as the near field point for 3 meter measurements.

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  $377\Omega$ . 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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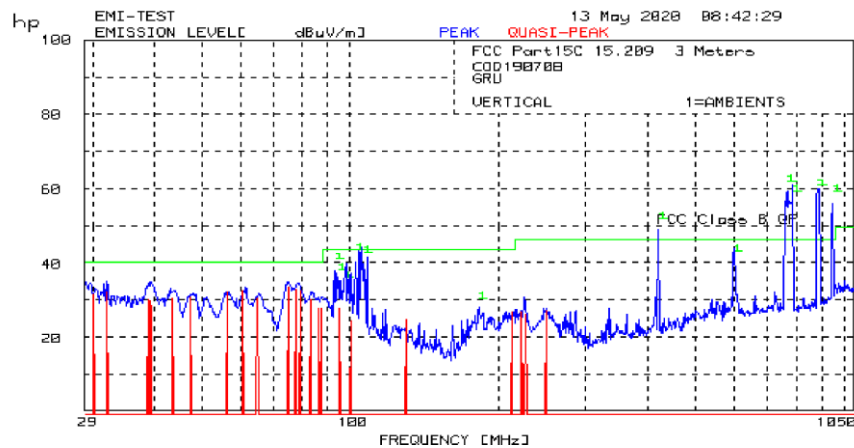
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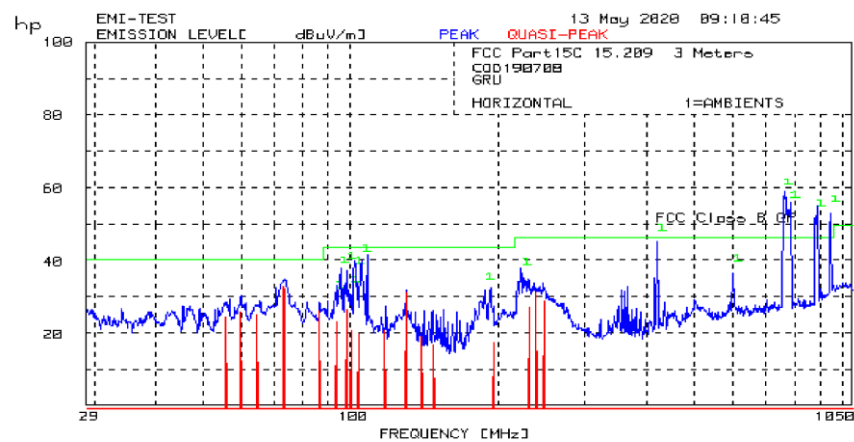
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### 11.5.3 Radiated Disturbances: 30MHz to 1000MHz at 3m distance



Radiated Emissions (30MHz to 1000MHz – Vertical)



Radiated Emissions (30MHz to 1000MHz - Horizontal)

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

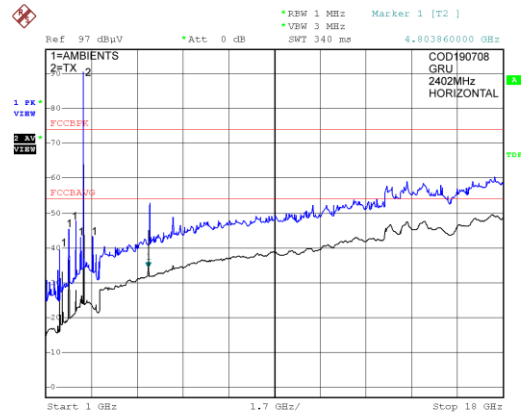
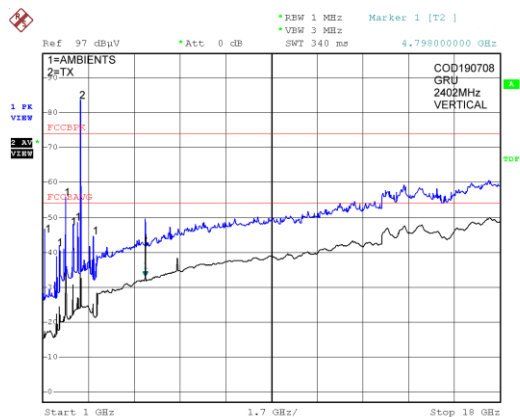
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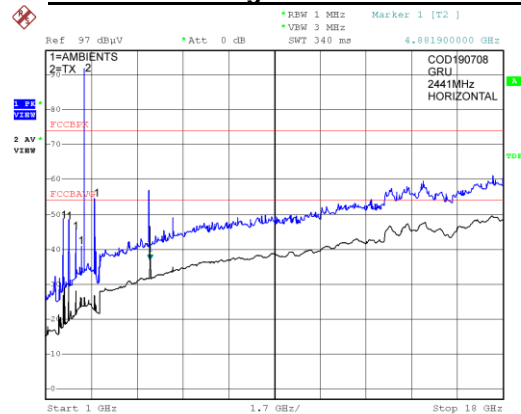
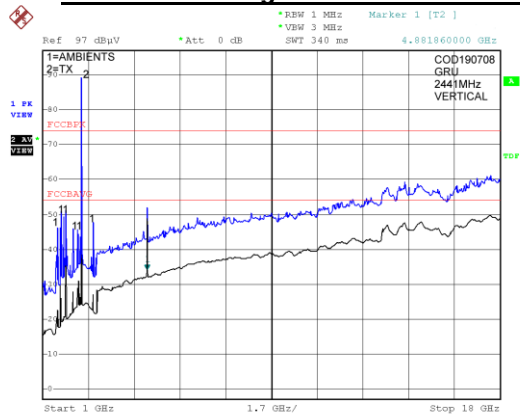
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#### 11.5.4 Radiated Disturbances: 1 GHz to 18 GHz at 3m distance

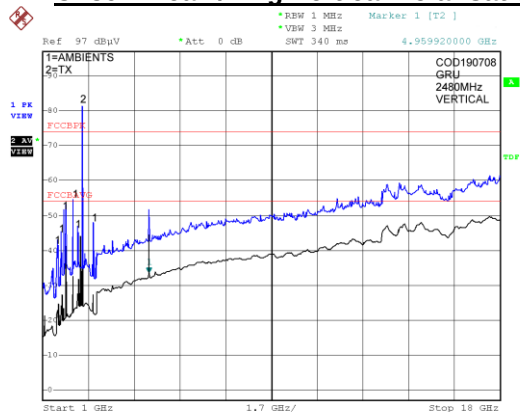


#### Ch0 – Peak / Avg Vertical Polarisation

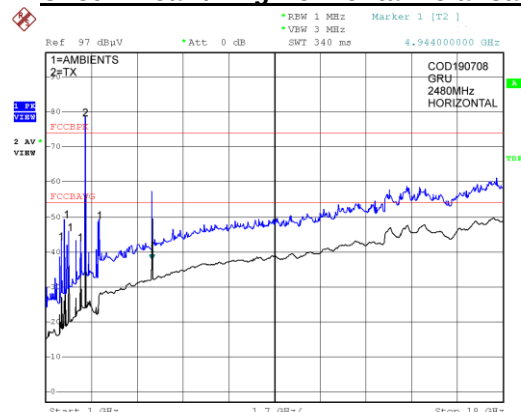


#### Ch0 – Peak / Avg Horizontal Polarisation

#### 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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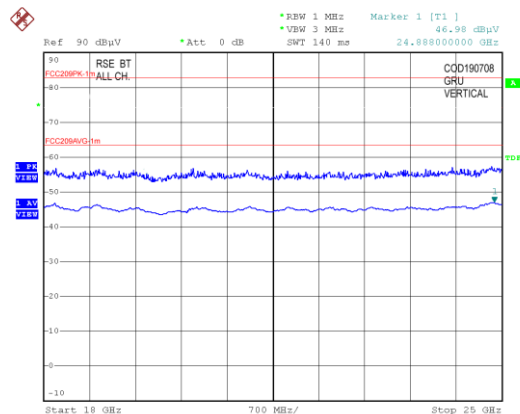


### 11.5.5 Radiated Disturbances: 18GHz to 25GHz at 1m distance

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.

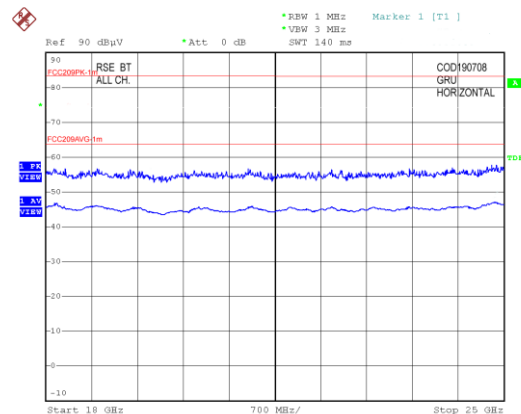
All intentional radiation spurious were greater than 10dB below the limits specified in FCC 15.209 and RSS-Gen. Emission levels were not affected by RF channel selection.

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.**

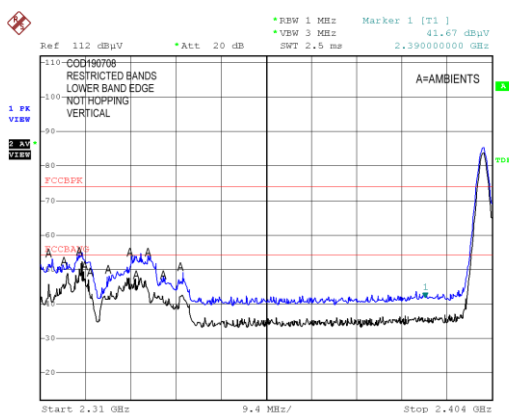
All measured disturbance levels were greater than 20dB below the FCC15.209 and RSS-Gen Peak limits.

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

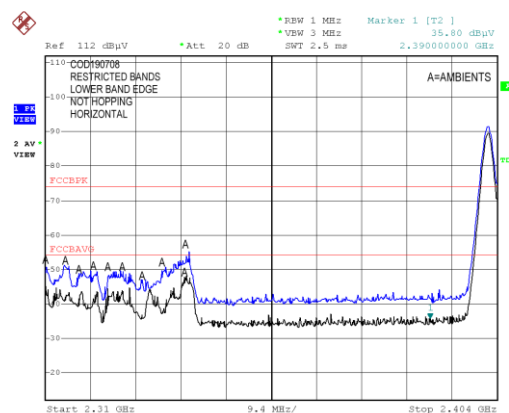
Both hopping and not hopping modes assessed.

**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

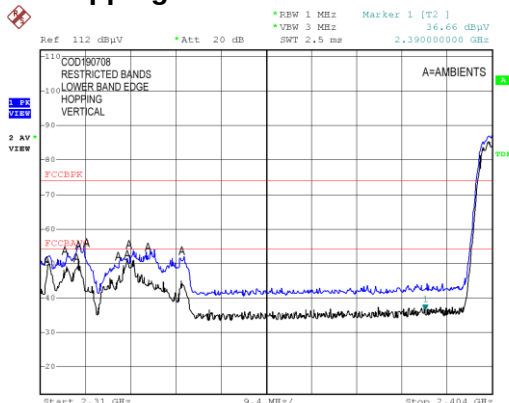


Date: 3.AUG.2020 10:11:01

### **Ch0 – Peak/Average Vertical Polarisation**

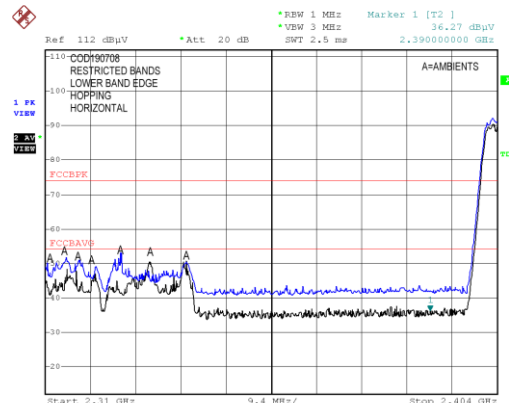
### Ch0 – Peak/Avg Horizontal Polarisation

### Hopping mode:



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

### Peak/Average Vertical Polarisation



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

### 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.

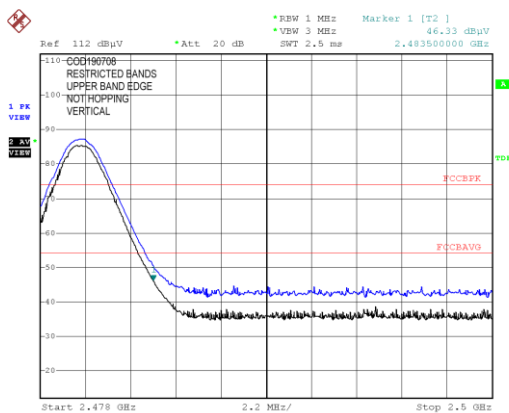
The highest measured Average disturbance was 2.6 dB below the FCC15.209 and RSS-Gen Average limit.

| Frequency MHz | Channel Number | Antenna Pol. | Pk Level dBμV/m | Pk Limit dBμV/m | Margin dB | Avg Level dBμV/m | Avg Limit dBμV/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.

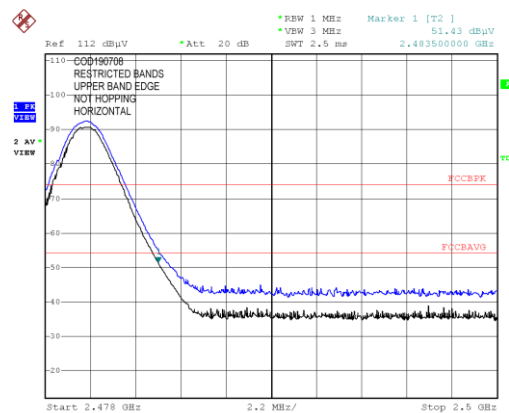
Both hopping and not hopping modes assessed.

### 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

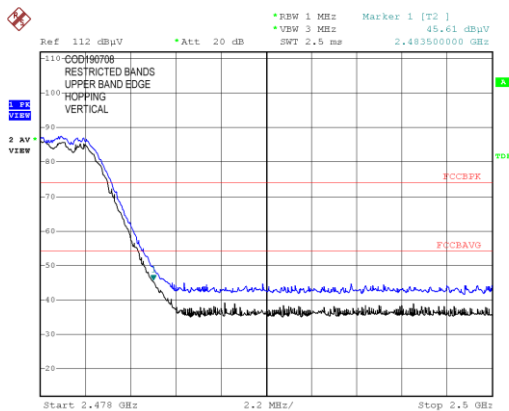
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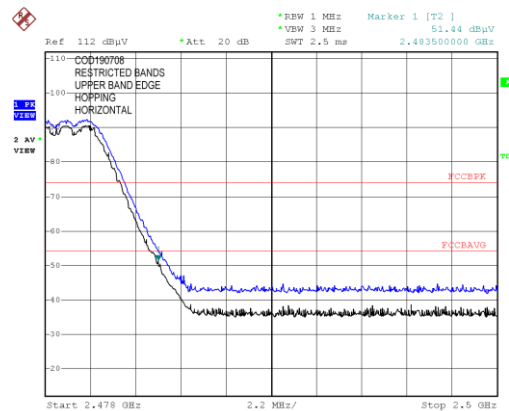


### Hopping mode:



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

### 12.1 EUT Operating Mode

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

- a. Measurements were performed in accordance with ANSI C63.10-2013 and KDB 558074 FHSS Measurement Guidance.
- b. The EUT was measured via the radiated method.
- c. 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

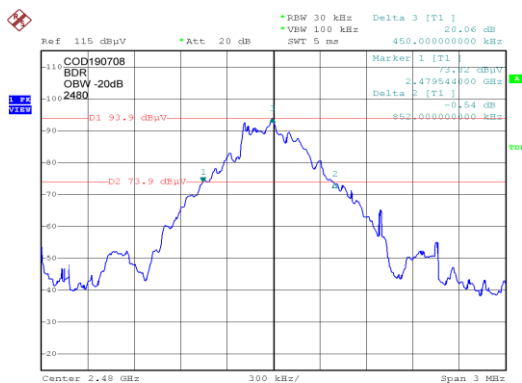


Date: 23.JUN.2020 13:00:52



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

#### 20dB Bandwidth- Ch0



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

#### 20dB Bandwidth- Ch39

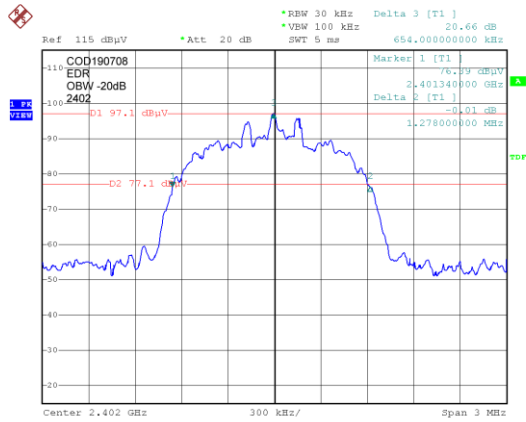


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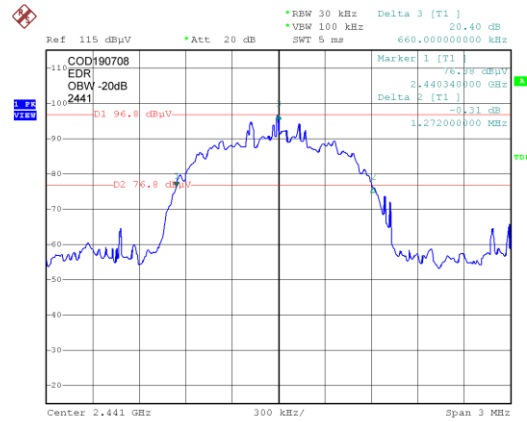
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## EDR – 8DPSK 3Mbps

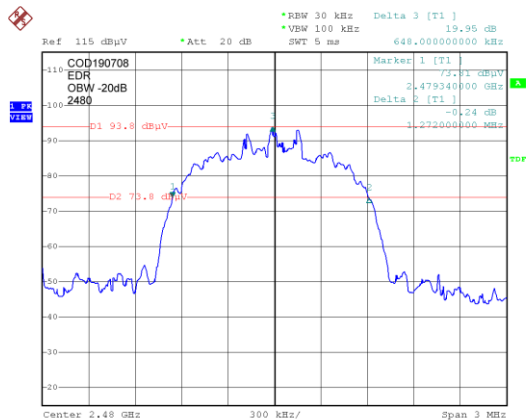


Date: 23.JUN.2020 14:41:15



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

## 20dB Bandwidth – Ch0



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

## 20dB Bandwidth – Ch39

## 20dB Bandwidth – Ch78

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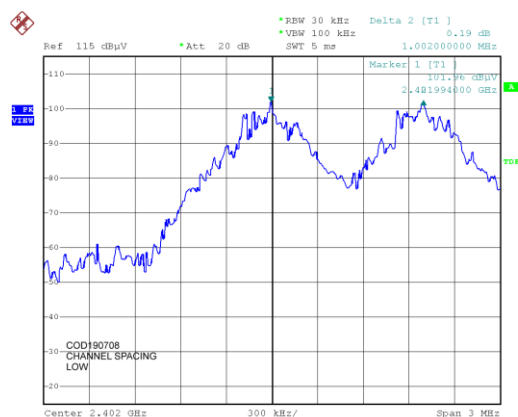
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### 12.3.2 Channel Separation

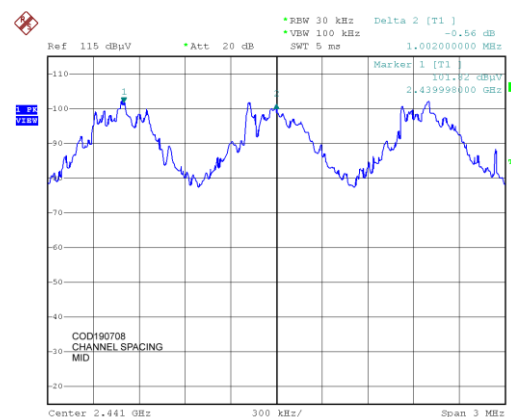
| Channel / Frequency MHz | Measured Separation (kHz) | 20dB Bandwidth (kHz) | 2/3 of 20dB Bandwidth Limit (kHz) |
|-------------------------|---------------------------|----------------------|-----------------------------------|
| 0 - (2402)              | 1002                      | 852                  | 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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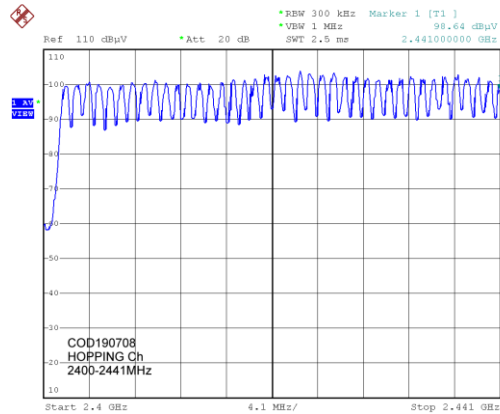
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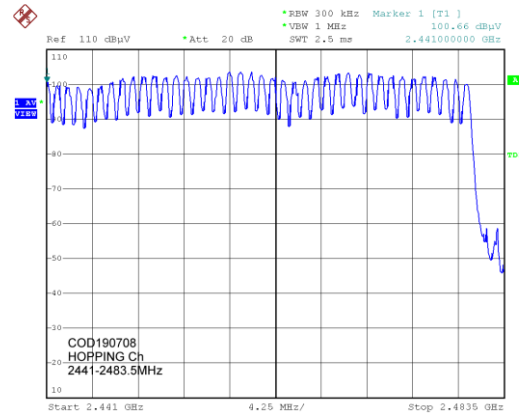
## 12.4 Number of Hopping Channels

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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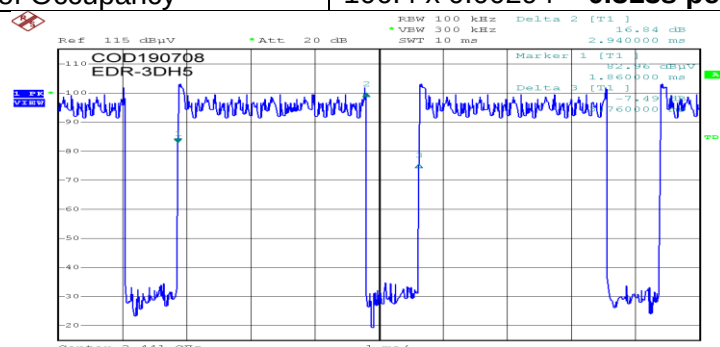


## 12.5 Time of Occupancy

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.

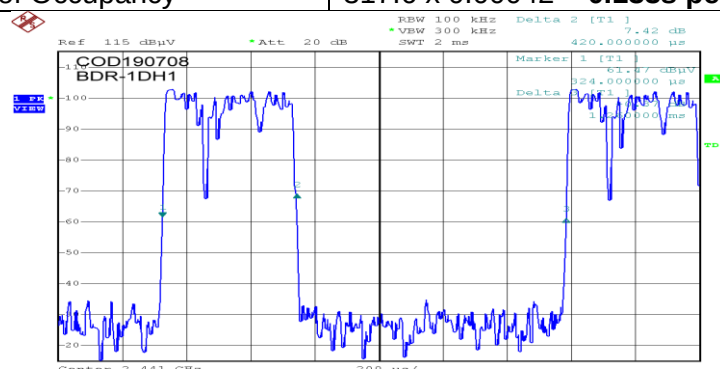
### EDR / 3DH5 mode (longest transmit time):

|                               |                                                            |
|-------------------------------|------------------------------------------------------------|
| 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 | $3.76 \times 79 = 297.0\text{ms}$                          |
| Hops on one channel in 31.6 s | $31.6 / 0.297 = 106.4$                                     |
| Average time of Occupancy     | $106.4 \times 0.00294 = \mathbf{0.313s \text{ per } 31.6}$ |



### 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 | $1.26 \times 79 = 99.5\text{ms}$                           |
| Hops on one channel in 31.6 s | $31.6 / 0.0995 = 317.6$                                    |
| Average time of Occupancy     | $317.6 \times 0.00042 = \mathbf{0.133s \text{ per } 31.6}$ |



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## 13 PEAK CONDUCTED OUTPUT POWER

|                |                                    |              |            |
|----------------|------------------------------------|--------------|------------|
| Test Date:     | 31 <sup>st</sup> July 2020         | Temperature: | 20°C, 18°C |
| Test Officer:  | Steven Garnham                     | Humidity:    | 61%, 82%   |
| Test Location: | Austest Laboratories (Yarramalong) |              |            |

### 13.1 EUT Operating Mode

- Battery voltage – 7.9VDC.
- Mode 1 – Constant BT transmission, EDR and BDR modes, ch0.
- Mode 2 – Constant BT transmission, EDR and BDR modes, ch39.
- 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.

- Measurements were performed in accordance with ANSI C63.10-2013 and KDB 558074 FHSS Meas Guidance.
- The EUT was measured via the radiated method then converted to a conducted output using the EUT's internal antenna gain.
- 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

- Spectrum analyser settings were 3MHz RBW, VBW 3MHz.
- The emission was maximum and the reading was recorded.
- 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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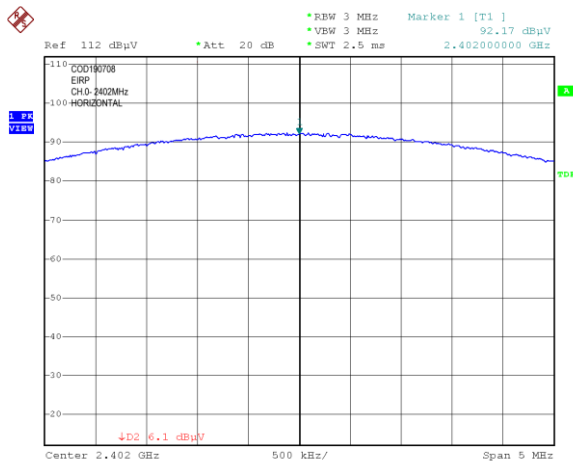
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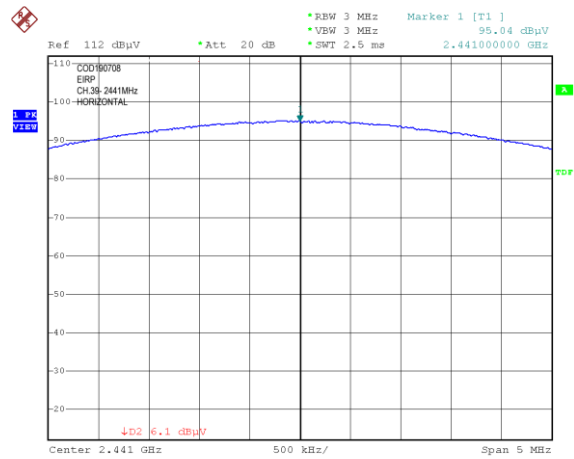


### 13.5 Test Results: EDR

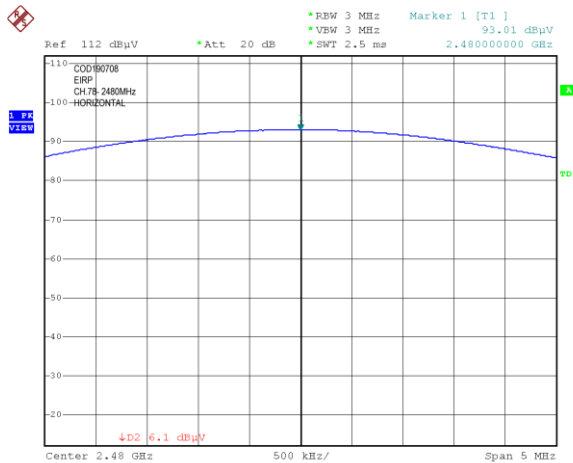
| Channel | Radiated EIRP Level |      | Equiv. Conducted Output Power |      |      | Limit |     | Margin |
|---------|---------------------|------|-------------------------------|------|------|-------|-----|--------|
|         | dBμV/m @ 3m         | dBm  | Ant. gain                     | dBm  | mW   | 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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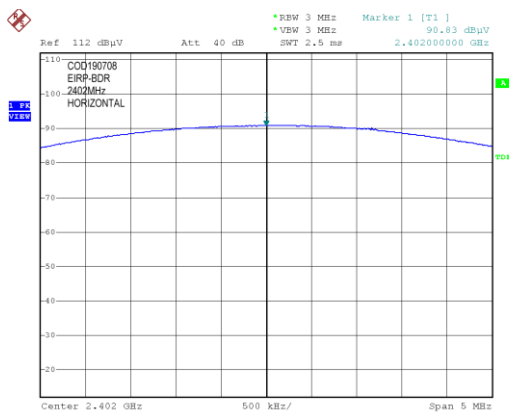
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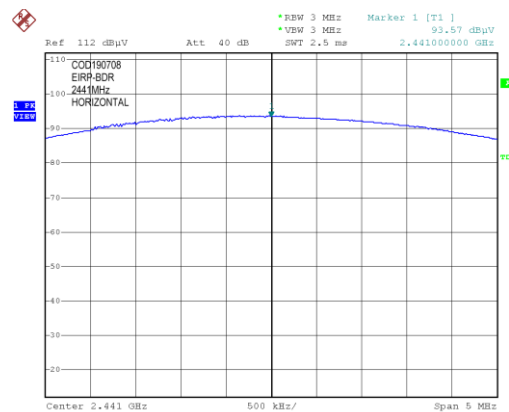
### 13.6 Test Results: BDR

| 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   |



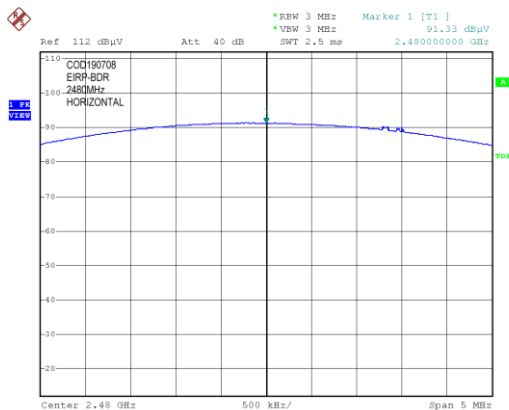
Date: 10.AUG.2020 08:49:45

#### 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:

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

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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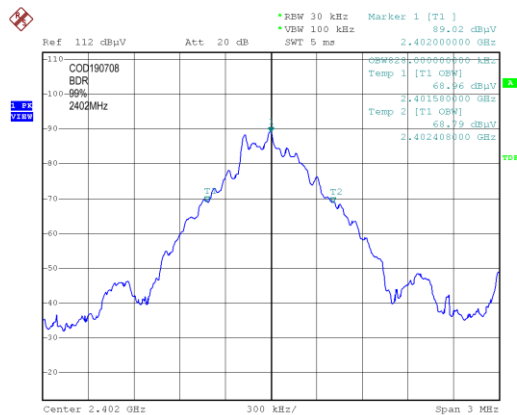
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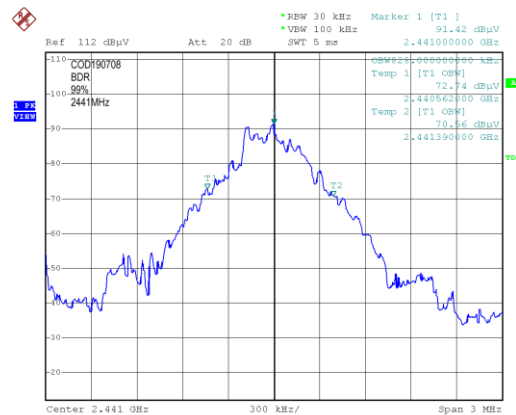
## 15 99% BANDWIDTH

| 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

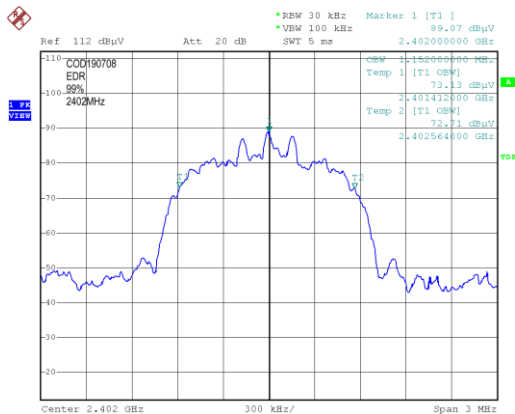
**BDR - 99% Bandwidth – Ch78**

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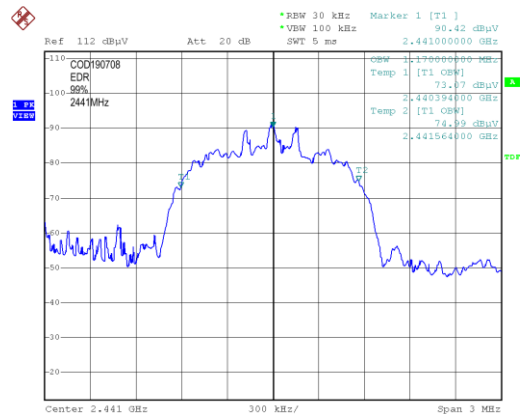
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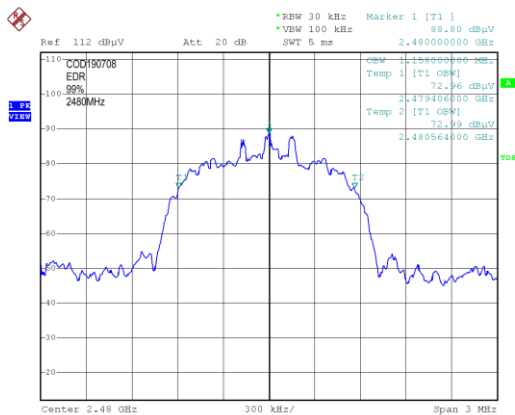
Date: 10.AUG.2020 09:00:14

### EDR - 99% Bandwidth – Ch0



Date: 10.AUG.2020 09:03:15

### EDR - 99% Bandwidth – Ch39



Date: 10.AUG.2020 09:52:37

### EDR - 99% Bandwidth – Ch78

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