



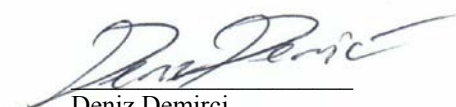
## Test Certificate

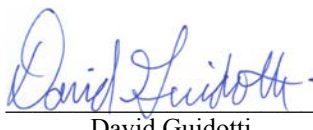
A sample of the following product received on February 27, 2020 and tested on February 27 and 28 and March 2, 3 and 4, 2020 complied with the requirements of,

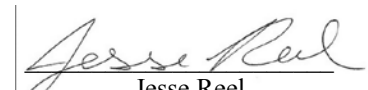
- Subpart B of Part 15 of FCC Rules for Class A digital devices
- Innovation, Science and Economic Development Canada Interference Causing Equipment Standard ICES-003, "Information Technology Equipment (ITE) – Limits and methods of measurement", Issue 6, dated January 2016 (Class A)

given the measurement uncertainties detailed in National Technical Systems report FR-113292.01-FCC Rev 1.

### Hexagon Mining Model HxGN MineProtect OAS-LV

  
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***EMC Test Report***  
***Information Technology Equipment***  
***Class A Digital Device***

***FCC Part 15***  
***Innovation, Science and Economic Development Canada ICES-003, Issue 6***

***Model: HxGN MineProtect OAS-LV***

COMPANY: Hexagon Mining  
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Tucson, AZ 85701

TEST SITE(S): National Technical Systems  
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PROJECT NUMBER: PR113292

REPORT DATE: March 30, 2020

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FINAL TEST DATES: February 27 and 28 and March 2, 3 and 4, 2020

TOTAL NUMBER OF PAGES: 73



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**VALIDATING SIGNATORIES****PROGRAM MGR**  
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## REVISION HISTORY

| Rev# | Date           | Comments                                                            | Modified By    |
|------|----------------|---------------------------------------------------------------------|----------------|
| -    | March 30, 2020 | First release                                                       |                |
| 1    | April 2, 2020  | Revised report to update the description of the product on page 10. | David Guidotti |

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## SCOPE

Governments and standards organizations around the world have published requirements regarding the electromagnetic compatibility (EMC) of electronic equipment. Testing has been performed on the Hexagon Mining model HxGN MineProtect OAS-LV, pursuant to the following standards.

| Standard               | Title                                                                                              | Standard Date           |
|------------------------|----------------------------------------------------------------------------------------------------|-------------------------|
| FCC Part 15, Subpart B | Radio Frequency Devices                                                                            | October 2018 as Amended |
| ICES-003, Issue 6      | Information Technology Equipment (Including Digital Apparatus) - Limits and Methods of Measurement | January 2016            |

All measurements and evaluations have been in accordance with these specifications, test procedures, and measurement guidelines as outlined in National Technical Systems test procedures, and in accordance with the standards referenced therein (refer to Appendix E). National Technical Systems is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

## OBJECTIVE

The objective of Hexagon Mining is to verify compliance with FCC and Canada's requirements for digital devices.

## STATEMENT OF COMPLIANCE

The tested sample(s) of Hexagon Mining model HxGN MineProtect OAS-LV complied with the requirements of:

| Standard/Regulation                                  | Equipment Type/Class | Standard Date   |
|------------------------------------------------------|----------------------|-----------------|
| Subpart B of Part 15 of the FCC Rules (CFR title 47) | Class A              | 2018 as amended |
| ICES-003, Issue 6                                    | Class A              | 2016            |

As specified in Section 15.101 of FCC Part 15, unintentional radiators shall be authorized prior to the initiation of marketing. Based on the description of the EUT, the following criteria per Section 15.101 of FCC Part 15 were applied to the EUT:

| Type of device                                                           | Equipment authorization required |
|--------------------------------------------------------------------------|----------------------------------|
| Class A digital devices, peripherals & external switching power supplies | SDoC or Certification            |

The test results recorded herein are based on a single type test of the Hexagon Mining model HxGN MineProtect OAS-LV and therefore apply only to the tested sample(s). The sample was selected and prepared by Marco Carvalho of Hexagon Mining.

Maintenance of compliance is the responsibility of the company. Any modification of the product that could result in increased emissions or susceptibility should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different enclosure, different line filter or power supply, harnessing and/or interface cable changes, etc.).

### ***DEVIATIONS FROM THE STANDARDS***

No deviations were made from the published requirements listed in the scope of this report.

## INFORMATION TECHNOLOGY EQUIPMENT EMISSIONS TEST RESULTS

The following emissions tests were performed on the Hexagon Mining model HxGN MineProtect OAS-LV. The measurements were extracted from the data recorded during testing and represent the highest-amplitude emissions relative to the specification limits. The complete test data is provided in the appendices of this report.

### CONDUCTED EMISSIONS (MAINS PORT)

Testing was not performed as the EUT is DC powered.

### RADIATED EMISSIONS

#### Test plan

| Configuration                                     | Test                        | Standard     | Test range      |
|---------------------------------------------------|-----------------------------|--------------|-----------------|
| LTE R202 Band 2<br>WiFi Ch 6 (2437 MHz)           | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 26 GHz |
| LTE R202 Band 12<br>WiFi Ch 36 (5180 MHz)         | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 40 GHz |
| LTE R202 Band 4<br>WiFi Ch 100 (5500 MHz)         | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 40 GHz |
| LTE R202 Band 5<br>WiFi Ch 165 (5825 MHz)         | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 40 GHz |
| LTE R204 (Verizon) Band 4<br>WiFi Ch 1 (2412 MHz) | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 26 GHz |
| LTE R204 (Verizon) Band 13<br>Bluetooth           | Radiated Spurious Emissions | FCC Part 15B | 30 MHz - 26 GHz |

#### Configuration #1

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                             | Requirement                                                            | Measurement Margin                    | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------------|---------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                    | 30-230 MHz,<br>40 dBµV/m<br>230-1000 MHz,<br>47 dBµV/m<br>(10 m limit) | 33.7 dBµV/m @ 105.75 MHz<br>(-6.3 dB) | Complied |
| 1-26.5 GHz                                                                                                                                                                                                                                                                                                                   | FCC §15.109(b)<br>Class A<br>FCC Part 15.247 | 49.5 dBµV/m Av<br>69.5 dBµV/m Pk<br>(10 m limit)                       | 47.1 dBµV/m @ 4874.1 MHz<br>(-6.9 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak). |                                              |                                                                        |                                       |          |

### Configuration #2

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                         | Requirement                                                            | Measurement Margin                     | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|------------------------------------------------------------------------|----------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                | 30-230 MHz,<br>40 dBμV/m<br>230-1000 MHz,<br>47 dBμV/m<br>(10 m limit) | 33.5 dBμV/m @ 105.73 MHz<br>(-6.5 dB)  | Complied |
| 1-40 GHz                                                                                                                                                                                                                                                                                                                     | FCC §15.109(b)<br>Class A<br>FCC Part 27 | 49.5 dBμV/m Av<br>69.5 dBμV/m Pk<br>(10 m limit)                       | 55.9 dBμV/m @ 1415.2 MHz<br>(-26.3 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBμV/m (Average) and 69.5 dBμV/m (Peak). |                                          |                                                                        |                                        |          |

### Configuration #3

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                              | Requirement                                                            | Measurement Margin                     | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|----------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                     | 30-230 MHz,<br>40 dBμV/m<br>230-1000 MHz,<br>47 dBμV/m<br>(10 m limit) | 36.4 dBμV/m @ 599.99 MHz<br>(-10.6 dB) | Complied |
| 1-40 GHz                                                                                                                                                                                                                                                                                                                     | FCC §15.109(b)<br>Class A<br>FCC Part 15E, 27 | 49.5 dBμV/m Av<br>69.5 dBμV/m Pk<br>(10 m limit)                       | 48.1 dBμV/m @ 6930.1 MHz<br>(-34.1 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBμV/m (Average) and 69.5 dBμV/m (Peak). |                                               |                                                                        |                                        |          |

### Configuration #4

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                              | Requirement                                                            | Measurement Margin                     | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|----------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                     | 30-230 MHz,<br>40 dBμV/m<br>230-1000 MHz,<br>47 dBμV/m<br>(10 m limit) | 36.8 dBμV/m @ 599.99 MHz<br>(-10.2 dB) | Complied |
| 1-40 GHz                                                                                                                                                                                                                                                                                                                     | FCC §15.109(b)<br>Class A<br>FCC Part 15E, 22 | 49.5 dBμV/m Av<br>69.5 dBμV/m Pk<br>(10 m limit)                       | 62.1 dBμV/m @ 17475.4 MHz<br>(-6.1 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBμV/m (Average) and 69.5 dBμV/m (Peak). |                                               |                                                                        |                                        |          |

### Configuration #5

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                                 | Requirement                                                            | Measurement Margin                    | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------|---------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                        | 30-230 MHz,<br>40 dBµV/m<br>230-1000 MHz,<br>47 dBµV/m<br>(10 m limit) | 38.9 dBµV/m @ 599.99 MHz<br>(-8.1 dB) | Complied |
| 1-25 GHz                                                                                                                                                                                                                                                                                                                     | FCC §15.109(b)<br>Class A<br>FCC Part 27, 15.247 | 49.5 dBµV/m Av<br>69.5 dBµV/m Pk<br>(10 m limit)                       | 46.6 dBµV/m @ 4824.0 MHz<br>(-7.4 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak). |                                                  |                                                                        |                                       |          |

### Configuration #6

| Frequency Range                                                                                                                                                                                                                                                                                                              | Standard/Section                                 | Requirement                                                            | Measurement Margin                    | Status   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------|---------------------------------------|----------|
| 30-1000 MHz                                                                                                                                                                                                                                                                                                                  | FCC §15.109(g)<br>Class A                        | 30-230 MHz,<br>40 dBµV/m<br>230-1000 MHz,<br>47 dBµV/m<br>(10 m limit) | 39.5 dBµV/m @ 600.00 MHz<br>(-7.5 dB) | Complied |
| 1-25 GHz                                                                                                                                                                                                                                                                                                                     | FCC §15.109(b)<br>Class A<br>FCC Part 27, 15.247 | 49.5 dBµV/m Av<br>69.5 dBµV/m Pk<br>(10 m limit)                       | 52.3 dBµV/m @ 7205.9 MHz<br>(-1.7 dB) | Complied |
| Note 1 For testing Class A devices to FCC Part 15 Subpart B using the test methods of ANSI C63.4-2014, readings are compared to a 3-meter limit derived from the 10-meter limit using the $20 \cdot \log(D1/D2)$ formula, i.e. adding 10.5 dB to the stated 10-meter limits of 49.5 dBµV/m (Average) and 69.5 dBµV/m (Peak). |                                                  |                                                                        |                                       |          |

## MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of  $k=2$ , which gives a level of confidence of approximately 95%. The levels were found to be below levels of CISPR and therefore no adjustment of the data for measurement uncertainty is required.

| Measurement Type        | Measurement Unit | Frequency Range | Expanded Uncertainty |
|-------------------------|------------------|-----------------|----------------------|
| Radiated Electric Field | dBµV/m           | 30-1000 MHz     | ± 3.6 dB             |
|                         |                  | 1000-40,000 MHz | ± 6.0 dB             |

**EQUIPMENT UNDER TEST (EUT) DETAILS****GENERAL**

The Hexagon Mining model HxGN MineProtect OAS-LV is a Fatigue Monitor Product for drivers. The EUT was treated as tabletop equipment during testing. The electrical rating of the EUT is 9 – 36 (12V Nominal) Volts DC 2 Amps (Max).

The sample was received on February 27, 2020 and tested on February 27 and 28 and March 2, 3 and 4, 2020. The EUT consisted of the following component(s):

| Company        | Product Name            | Model | Description             | Article Number | Serial Number | FCC ID         |
|----------------|-------------------------|-------|-------------------------|----------------|---------------|----------------|
| Hexagon Mining | HxGN MineProtect OAS-LV | 202   | Fatigue Monitor Product | 898411         | 1000004       | 2AFYJ-OASLV202 |
| Hexagon Mining | HxGN MineProtect OAS-LV | 204   | Fatigue Monitor Product | 905058         | 4000003       | 2AFYJ-OASLV204 |

**HIGHEST EUT INTERNAL FREQUENCY SOURCE**

The highest internal frequency source ( $F_x$ ) of an EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. The highest internal frequency source determines the frequency range of test for radiated emissions.

The highest internal frequency source of the EUT was declared to be 5850 MHz.

Based on the declared highest internal frequency source, the upper frequency range of measurement for the current project were:

**FCC Part 15, Subpart B**

| Highest Internal Frequency Source (MHz) | Upper Frequency Range of Measurement (MHz)                                | Applicability |
|-----------------------------------------|---------------------------------------------------------------------------|---------------|
| Below 1.705                             | 30                                                                        |               |
| 1.705 – 108                             | 1000                                                                      |               |
| 108 – 500                               | 2000                                                                      |               |
| 500 – 1000                              | 5000                                                                      |               |
| Above 1000                              | 5th harmonic of the highest internal source or 40 GHz, whichever is lower | X             |

**ENCLOSURE**

The EUT enclosure is aluminum base plate with Powder Coat finish for protection against corrosion and sunlight (UV). Plastic ABS top enclosure Length (cm) 15 x width (cm) 12 x Height (cm) 5.

**MODIFICATIONS**

No modifications were made to the EUT during the time the product was at National Technical Systems.

**SUPPORT EQUIPMENT**

The following equipment was used as local support equipment for testing:

| Company | Model        | Description              | Serial Number |
|---------|--------------|--------------------------|---------------|
| EMCO    | 3115         | GNSS re-radiator antenna | -             |
| EMCO    | 3115         | LTE re-radiator antenna  | -             |
| -       | 12 V battery |                          | -             |

The following equipment was used as remote support equipment for testing:

| Company | Model          | Description  | Serial Number |
|---------|----------------|--------------|---------------|
| R&S     | CMW 500        | LTE call box | WC064877      |
| HP      | Bang & Olufsen | Laptop       | -             |

**EUT INTERFACE PORTS**

The I/O cabling configuration during testing was as follows:

| Port      |                           | Cable(s)       |                     |           |
|-----------|---------------------------|----------------|---------------------|-----------|
| From      | To                        | Description    | Shielded/Unshielded | Length(m) |
| GPS       | GPS antenna               | RF cable       | Shielded            | 2.0       |
| Mini USB  | USB memory                | USB cable      | Shielded            | 0.3       |
| DC power  | Battery                   | DC Power cable | Unshielded          | 2.0       |
| Micro USB | Unterminated (future use) | USB cable      | Shielded            | 1.6       |

**EUT OPERATION**

During emissions testing the LTE modem was transmitting at the specified band with max power, Wi-Fi or Bluetooth were transmitting with max RF power, Camera was active, writing to SD card and USB stick. GPS was receiving satellites.

**EMISSIONS TESTING****RADIATED EMISSIONS**

Final test measurements were taken at the National Technical Systems Anechoic Chambers listed below. The test sites contain separate areas for radiated and conducted emissions testing. The sites conform to the requirements of ANSI C63.4-2014 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2017 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. They are registered with the VCCI and are on file with the FCC and Industry Canada.

| Site          | Registration Numbers                              |        |        | Location                                   |
|---------------|---------------------------------------------------|--------|--------|--------------------------------------------|
|               | VCCI                                              | FCC    | Canada |                                            |
| Chamber 4 & 7 | Member 1211<br>Facility<br>Registration<br>A-0169 | US1031 | US0027 | 41039 Boyce Road<br>Fremont, CA 94538-2435 |

## **EMISSIONS MEASUREMENT INSTRUMENTATION**

### **RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1-1:2015 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 7 GHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000 MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

### **INSTRUMENT CONTROL COMPUTER**

Measurements for radiated and conducted emissions are converted to the field strength at an antenna or voltage developed at the LISN (or ISN) measurement port, which is then compared directly with the appropriate specification limit under software control of the test receivers and spectrum analyzers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically. The software used for measurements is NTS EMI Test Software (rev 2.10).

### **FILTERS/ATTENUATORS**

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high-amplitude transient events.

**ANTENNAS**

A bilog antenna or combination of biconical and log periodic antennas are used to cover the range from 30 MHz to 1000 MHz. Narrowband tuned dipole antennas may be used over the entire 30 to 1000 MHz frequency range for precision measurements of field strength. Above 1000 MHz, horn antennas are used. The antenna calibration factors are included in site factors that are programmed into the test receivers or data collection software.

**ANTENNA MAST AND EQUIPMENT TURNTABLE**

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table-mounted devices shall be 80 cm. Floor-mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material up to 12 mm thick if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

**INSTRUMENT CALIBRATION**

All test equipment is regularly checked to ensure that performance is maintained in accordance with the company's specifications. An appendix of this report contains the list of test equipment used and calibration information.

## **EMISSIONS TEST PROCEDURES**

### **EUT AND CABLE PLACEMENT**

The standards require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst-case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst-case orientation is used for final measurements.

### **RADIATED EMISSIONS**

#### **General**

FCC Part 15 references the test methods of ANSI C63.4-2014 (American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz) for emissions measurements. Radiated emissions measurements are performed in two phases, preliminary scan and final maximization.

#### **Preliminary Scan**

A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one or more of these with the antenna polarized vertically and one or more of these are performed with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied as necessary to determine the highest emission relative to the limit.

Note that for the frequency range of 1-6 GHz in the “free space” test environment, CISPR 32 allows the antenna to be set at a fixed height equal to the center height of the EUT, except for cases where additional scans are necessary with the antenna height adjusted up and down to ensure the measurement antenna illuminates the entire height of the EUT. However, in cases where a single “free space” test is performed in the 1-6 GHz frequency to simultaneously meet the requirements of FCC Part 15 (ANSI C63.4-2014 test methods) and CISPR 22, the antenna height is by default varied since required by ANSI C63.4.

In the frequency range of 30-1000 MHz, a speaker (with demodulation) is provided in the receiver to aid in discriminating between EUT and ambient emissions if required. Other possible methods for discriminating between EUT and ambient emissions involve scanning with near-field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

### Final Maximization

During final maximization, the highest-amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth that results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions that have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

Final measurements in the frequency range of 30-1000 MHz are made using a quasi-peak detector and compared to the quasi-peak limit. Final measurements above 1 GHz are made using average and peak detectors and compared to the average and peak limits respectively.

The diameter of the test volume demonstrated during the test site validation of Chamber 4 was 2.5 m, while the maximum width of the boundary of the EUT, local AE, and associated cabling within the test volume was 2.5 m.

The diameter of the test volume demonstrated during the test site validation of Chamber 7 was 2.5 m, while the maximum width of the boundary of the EUT, local AE, and associated cabling within the test volume was 2.5 m.

When testing above 1 GHz, the receive antenna is restricted to a maximum height of 2.5 m. Maximum emissions are found within this restricted range because emission levels decrease over distance and as the antenna is raised above 2.5 m, the distance from the EUT increases. As a result of the increased measurement distance, at antenna heights above 2.5 m, lower emission levels are measured as compared to emissions levels measured at antenna heights at 2.5 m and below. Final measurements are captured at 3 meters test distance except in cases where a closer test distance is required due to noise-floor considerations of the test-and-measurement equipment.

For measurements above 1 GHz every effort is made to ensure the EUT remains within the cone of radiation of the measurement antenna (i.e. 3 dB beam-width of the antenna). This may include rotating the product and/or angling the measurement antenna. A horn antenna having the beam width  $W$  at the measurement distance 3 m shown in the table below was used for the measurement. Since the height of the EUT from the turntable was 1.5 m, the antenna height was fixed to 1 m.

| Frequency (GHz) | E Plane | H Plane | $\Theta_{3dB}$ | 3 dB beam width $W$ (m) at 3 m |
|-----------------|---------|---------|----------------|--------------------------------|
| 1.0             | 110     | 90      | 90             | 6.0                            |
| 2.0             | 50      | 59      | 50             | 2.8                            |
| 3.0             | 40      | 62      | 40             | 2.2                            |
| 4.0             | 42      | 63      | 42             | 2.3                            |
| 5.0             | 54      | 42      | 42             | 2.3                            |
| 6.0             | 48      | 39      | 39             | 2.1                            |

## **SAMPLE CALCULATIONS**

### **SAMPLE CALCULATIONS - RADIATED EMISSIONS**

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

$$F_d = \text{Distance Factor in dB}$$

$$D_m = \text{Measurement Distance in meters}$$

$$D_s = \text{Specification Distance in meters}$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$$R_r = \text{Receiver Reading in dB}\mu\text{V/m}$$

$$F_d = \text{Distance Factor in dB}$$

$$R_c = \text{Corrected Reading in dB}\mu\text{V/m}$$

$$L_s = \text{Specification Limit in dB}\mu\text{V/m}$$

$$M = \text{Margin in dB Relative to Spec}$$

## Appendix A Test Equipment Calibration Data

| <u>Manufacturer</u>                                      | <u>Description</u>                   | <u>Model</u>   | <u>Asset #</u> | <u>Calibrated</u> | <u>Cal Due</u> |
|----------------------------------------------------------|--------------------------------------|----------------|----------------|-------------------|----------------|
| <b>Radiated Emissions, 30 - 18,000 MHz, 27-Feb-20</b>    |                                      |                |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)          | N/A            | WC022452       | N/A               |                |
| Hewlett Packard                                          | Spectrum Analyzer (Red)              | 8564E (84125C) | WC055584       | 10/10/2019        | 10/10/2020     |
| Micro-Tronics                                            | High Pass Filter 2.7 GHz (High Pass) | HPM50111-01    | WC062506       | 11/25/2019        | 11/25/2020     |
| Hewlett Packard                                          | Microwave Preamplifier, 1 - 26.5 GHz | 8449B          | WC064416       | 7/18/2019         | 7/18/2020      |
| Filtek Filters                                           | High Pass Filter, 1 GHz              | HP12/1000-5BA  | WC064427       | 4/25/2019         | 4/25/2020      |
| EMCO                                                     | Antenna, Horn, 1-18 GHz (SA40-Red)   | 3115           | WC064432       | 9/18/2018         | 9/18/2020      |
| Sunol Sciences                                           | Biconilog, 30-3000 MHz               | JB3            | WC064454       | 3/11/2019         | 3/11/2021      |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz       | ESIB 7         | WC064492       | 6/22/2019         | 6/22/2020      |
| Hewlett Packard                                          | High Pass Filter, 8.2 GHz            | 84300-80039    | WC064496       | 7/15/2019         | 7/15/2020      |
| Micro-Tronics                                            | Band Reject Filter, 5150-5350 MHz    | BRC50703-02    | WC064584       | 6/28/2019         | 6/28/2020      |
| Hewlett Packard                                          | 9 KHz-1300 MHz pre-amp               | 8447F          | WC064718       | 12/2/2019         | 12/2/2020      |
| SM Electronics                                           | Attenuator                           | SA18B-10       | WC072177       | N/A               |                |
| <b>Radiated Emissions, 30 - 40,000 MHz, 28-Feb-20</b>    |                                      |                |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)          | N/A            | WC022452       | N/A               |                |
| Hewlett Packard                                          | Spectrum Analyzer (Red)              | 8564E (84125C) | WC055584       | 10/10/2019        | 10/10/2020     |
| Hewlett Packard                                          | Microwave Preamplifier               | 84125C EMI     | WC055586       | 10/4/2019         | 10/4/2020      |
| Micro-Tronics                                            | Head, 18-40 GHz (Red)                | Test Head      |                |                   |                |
| Micro-Tronics                                            | Filter (High Pass)                   | HPM50111-01    | WC062506       | 11/25/2019        | 11/25/2020     |
| Hewlett Packard                                          | Microwave Preamplifier, 1-26.5GHz    | 8449B          | WC064416       | 7/18/2019         | 7/18/2020      |
| Filtek Filters                                           | Filter, 1 GHz High Pass              | HP12/1000-5BA  | WC064427       | 4/25/2019         | 4/25/2020      |
| EMCO                                                     | Antenna, Horn, 1-18 GHz (SA40-Red)   | 3115           | WC064432       | 9/18/2018         | 9/18/2020      |
| Sunol Sciences                                           | Biconilog, 30-3000 MHz               | JB3            | WC064454       | 3/11/2019         | 3/11/2021      |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz       | ESIB 7         | WC064492       | 6/22/2019         | 6/22/2020      |
| Hewlett Packard                                          | High Pass filter, 8.2 GHz            | 84300-80039    | WC064496       | 7/15/2019         | 7/15/2020      |
| A. H. Systems                                            | Antenna, Horn, 18-40GHz              | SAS-574        | WC064555       | 7/8/2019          | 7/8/2021       |
| Micro-Tronics                                            | Band Reject Filter, 5150-5350 MHz    | BRC50703-02    | WC064584       | 6/28/2019         | 6/28/2020      |
| Hewlett Packard                                          | 9KHz-1300MHz pre-amp                 | 8447F          | WC064718       | 12/2/2019         | 12/2/2020      |
| SM Electronics                                           | Attenuator                           | SA18B-10       | WC072177       | N/A               |                |
| <b>Radiated Emissions, 1,000 - 25,000 MHz, 02-Mar-20</b> |                                      |                |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)          | N/A            | WC022452       | N/A               |                |
| Hewlett Packard                                          | Spectrum Analyzer (Red)              | 8564E (84125C) | WC055584       | 10/10/2019        | 10/10/2020     |
| Hewlett Packard                                          | Microwave Preamplifier               | 84125C EMI     | WC055586       | 10/4/2019         | 10/4/2020      |
| Micro-Tronics                                            | Head, 18-40 GHz (Red)                | Test Head      |                |                   |                |
| Micro-Tronics                                            | Filter (High Pass)                   | HPM50111-01    | WC062506       | 11/25/2019        | 11/25/2020     |
| Hewlett Packard                                          | Microwave Preamplifier, 1-26.5GHz    | 8449B          | WC064416       | 7/18/2019         | 7/18/2020      |



| <u>Manufacturer</u>                                      | <u>Description</u>                           | <u>Model</u>         | <u>Asset #</u> | <u>Calibrated</u> | <u>Cal Due</u> |
|----------------------------------------------------------|----------------------------------------------|----------------------|----------------|-------------------|----------------|
| EMCO                                                     | Antenna, Horn, 1-18 GHz (SA40-Red)           | 3115                 | WC064432       | 9/18/2018         | 9/18/2020      |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz               | ESIB 7               | WC064492       | 6/22/2019         | 6/22/2020      |
| A. H. Systems                                            | Antenna, Horn, 18-40GHz                      | SAS-574              | WC064555       | 7/8/2019          | 7/8/2021       |
| <b>Radiated Emissions, 1,000 - 40,000 MHz, 03-Mar-20</b> |                                              |                      |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)                  | N/A                  | WC022452       | N/A               |                |
| Hewlett Packard                                          | Spectrum Analyzer (Red)                      | 8564E (84125C)       | WC055584       | 10/10/2019        | 10/10/2020     |
| Hewlett Packard                                          | Microwave Preamplifier Head, 18-40 GHz (Red) | 84125C EMI Test Head | WC055586       | 10/4/2019         | 10/4/2020      |
| Micro-Tronics                                            | Filter (High Pass)                           | HPM50111-01          | WC062506       | 11/25/2019        | 11/25/2020     |
| Hewlett Packard                                          | Microwave Preamplifier, 1-26.5GHz            | 8449B                | WC064416       | 7/18/2019         | 7/18/2020      |
| Filtek Filters                                           | Filter, 1 GHz High Pass                      | HP12/1000-5BA        | WC064427       | 4/25/2019         | 4/25/2020      |
| EMCO                                                     | Antenna, Horn, 1-18 GHz (SA40-Red)           | 3115                 | WC064432       | 9/18/2018         | 9/18/2020      |
| A. H. Systems                                            | Antenna, Horn, 18-40GHz                      | SAS-574              | WC064555       | 7/8/2019          | 7/8/2021       |
| SM Electronics                                           | Attenuator                                   | SA18B-10             | WC072177       | N/A               |                |
| <b>Radiated Emissions, 30 - 26,000 MHz, 04-Mar-20</b>    |                                              |                      |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)                  | N/A                  | WC022452       | N/A               |                |
| Hewlett Packard                                          | Spectrum Analyzer (Red)                      | 8564E (84125C)       | WC055584       | 10/10/2019        | 10/10/2020     |
| Hewlett Packard                                          | Microwave Preamplifier Head, 18-40 GHz (Red) | 84125C EMI Test Head | WC055586       | 10/4/2019         | 10/4/2020      |
| Micro-Tronics                                            | Filter (High Pass)                           | HPM50111-01          | WC062506       | 11/25/2019        | 11/25/2020     |
| Hewlett Packard                                          | Microwave Preamplifier, 1-26.5GHz            | 8449B                | WC064416       | 7/18/2019         | 7/18/2020      |
| Filtek Filters                                           | Filter, 1 GHz High Pass                      | HP12/1000-5BA        | WC064427       | 4/25/2019         | 4/25/2020      |
| EMCO                                                     | Antenna, Horn, 1-18 GHz (SA40-Red)           | 3115                 | WC064432       | 9/18/2018         | 9/18/2020      |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz               | ESIB7                | WC064455       | 2/11/2020         | 2/11/2021      |
| A. H. Systems                                            | Antenna, Horn, 18-40GHz                      | SAS-574              | WC064555       | 7/8/2019          | 7/8/2021       |
| Sunol Sciences                                           | Biconilog, 30-3000 MHz                       | JB3                  | WC064582       | 7/3/2018          | 7/3/2020       |
| SM Electronics                                           | Attenuator                                   | SA18B-10             | WC072177       | N/A               |                |
| <b>Radiated Emissions, 30 - 1,000 MHz, 05-Mar-20</b>     |                                              |                      |                |                   |                |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz               | ESIB7                | WC064455       | 2/11/2020         | 2/11/2021      |
| Sunol Sciences                                           | Biconilog, 30-3000 MHz                       | JB3                  | WC064582       | 7/3/2018          | 7/3/2020       |
| <b>Radiated Emissions, 30 - 1,000 MHz, 06-Mar-20</b>     |                                              |                      |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)                  | N/A                  | WC022452       | N/A               |                |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz               | ESIB7                | WC064455       | 2/11/2020         | 2/11/2021      |
| Sunol Sciences                                           | Biconilog, 30-3000 MHz                       | JB3                  | WC064582       | 7/3/2018          | 7/3/2020       |
| <b>Radiated Emissions, 30 - 1,000 MHz, 09-Mar-20</b>     |                                              |                      |                |                   |                |
| National Technical Systems                               | NTS EMI Software (rev 2.10)                  | N/A                  | WC022452       | N/A               |                |
| Rohde & Schwarz                                          | EMI Test Receiver, 20 Hz-7 GHz               | ESIB7                | WC064455       | 2/11/2020         | 2/11/2021      |



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| <u>Manufacturer</u> | <u>Description</u>     | <u>Model</u> | <u>Asset #</u> | <u>Calibrated</u> | <u>Cal Due</u> |
|---------------------|------------------------|--------------|----------------|-------------------|----------------|
| Sunol Sciences      | Biconilog, 30-3000 MHz | JB3          | WC064582       | 7/3/2018          | 7/3/2020       |

## ***Appendix B Test Data***

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## EMC Test Data

|                        |                                     |                   |                   |
|------------------------|-------------------------------------|-------------------|-------------------|
| Client:                | Hexagon Mining                      | PR Number:        | PR113292          |
| Product                | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| System Configuration:  | -                                   | Project Manager:  | Christine Krebill |
| Contact:               | Marco Carvalho                      | Project Engineer: | Deniz Demirci     |
| Emissions Standard(s): | FCC 15B, CISPR 32, EN 301 489       | Class:            | A                 |
| Immunity Standard(s):  | EN 55024, EN 301 489-1/-3/-17/-52   | Environment:      | -                 |

## EMC Test Data

For The

## Hexagon Mining

Product

**HxGN MineProtect OAS-LV 202 and 204**

Date of Last Test: 3/16/2020



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/27/2020  
Test Engineer: Deniz Demirci  
Test Location: Fremont Chamber #4

Config. Used: 1  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

#### Ambient Conditions:

Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                          | Result | Margin                                |
|-------|--------------------------------------------------|--------------------------------|--------|---------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                        | Eval   | Refer to individual runs              |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                        | Pass   | 33.7 dBμV/m @ 105.75 MHz<br>(-6.3 dB) |
| 3     | Radiated Emissions<br>1 GHz - 26.5 GHz Maximized | FCC Class A<br>FCC Part 15.247 | Pass   | 47.1 dBμV/m @ 4874.1 MHz<br>(-6.9 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

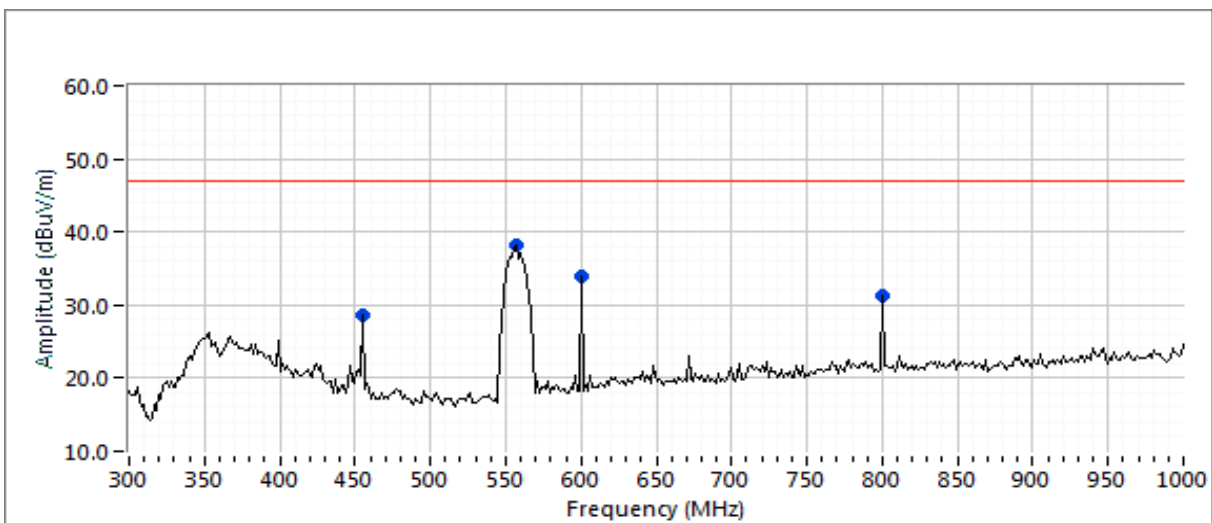
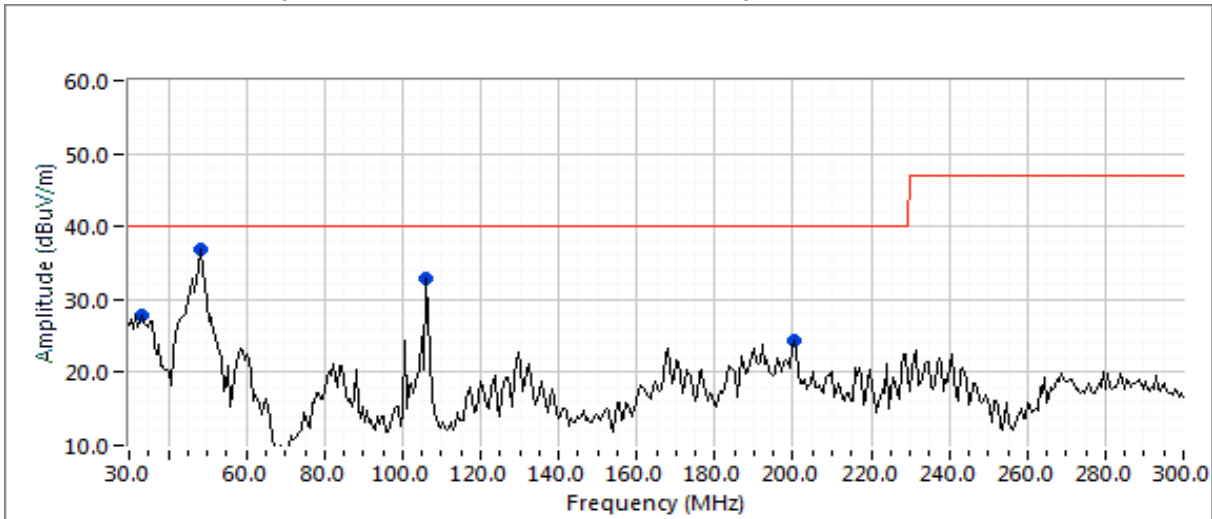
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R202) is transmitting at 1880 MHz (Ch# 18900) with max power, 802.11b Ch#6 transmitting with max RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments                       |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|--------------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |                                |
| 33.246    | 27.7         | V   | 40.0                | -12.3  | Peak      | 156     | 1.0    |                                |
| 48.397    | 36.8         | V   | 40.0                | -3.2   | Peak      | 26      | 1.0    |                                |
| 105.752   | 33.0         | H   | 40.0                | -7.0   | Peak      | 291     | 2.0    |                                |
| 200.441   | 24.4         | H   | 40.0                | -15.6  | Peak      | 57      | 3.5    |                                |
| 455.711   | 28.6         | H   | 47.0                | -18.4  | Peak      | 74      | 1.0    |                                |
| 556.713   | 38.3         | H   | 47.0                | -8.7   | Peak      | 120     | 3.0    | LTE and Wi-Fi intermodulation. |
| 600.200   | 34.0         | H   | 47.0                | -13.0  | Peak      | 99      | 2.5    |                                |
| 800.802   | 31.4         | H   | 47.0                | -15.6  | Peak      | 76      | 3.5    |                                |

### Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments                     |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|------------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |                              |
| 33.537    | 25.7         | V   | 40.0                | -14.3  | QP        | 156     | 1.1    | QP (1.00s)                   |
| 48.448    | 29.3         | V   | 40.0                | -10.7  | QP        | 38      | 1.0    | QP (1.00s)                   |
| 105.753   | 32.6         | H   | 40.0                | -7.4   | QP        | 277     | 2.0    | QP (1.00s)                   |
| 200.001   | 23.6         | H   | 40.0                | -16.4  | QP        | 68      | 3.3    | QP (1.00s)                   |
| 456.022   | 28.9         | H   | 47.0                | -18.1  | QP        | 69      | 1.1    | QP (1.00s)                   |
| 557.428   | 34.3         | H   | 47.0                | -12.7  | QP        | 118     | 3.0    | QP (1.00s) - Intermodulation |
| 599.990   | 35.7         | H   | 47.0                | -11.3  | QP        | 111     | 2.8    | QP (1.00s)                   |
| 800.002   | 27.7         | H   | 47.0                | -19.3  | QP        | 0       | 1.0    | QP (1.00s)                   |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                           |                            |                                               |
|------------------------------------------|---------------------------|----------------------------|-----------------------------------------------|
| Frequency Range<br>(MHz)                 | Test Distance<br>(meters) | Limit Distance<br>(meters) | Extrapolation Factor<br>(dB, applied to data) |
| 30 - 1000                                | 5                         | 10                         | -6.0                                          |

### Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency      | Level        | Pol | CISPR 22/32 Class A |             | Detector  | Azimuth | Height | Comments                     |
|----------------|--------------|-----|---------------------|-------------|-----------|---------|--------|------------------------------|
| MHz            | dB $\mu$ V/m | v/h | Limit               | Margin      | Pk/QP/Avg | degrees | meters |                              |
| <b>105.753</b> | <b>33.7</b>  | H   | 40.0                | <b>-6.3</b> | QP        | 277     | 2.0    | QP (1.00s)                   |
| 48.448         | 32.4         | V   | 40.0                | -7.6        | QP        | 38      | 1.0    | QP (1.00s)                   |
| 599.990        | 35.7         | H   | 47.0                | -11.3       | QP        | 111     | 2.8    | QP (1.00s)                   |
| 33.537         | 27.8         | V   | 40.0                | -12.2       | QP        | 156     | 1.1    | QP (1.00s)                   |
| 557.428        | 34.3         | H   | 47.0                | -12.7       | QP        | 118     | 3.0    | QP (1.00s) - Intermodulation |
| 200.001        | 24.4         | H   | 40.0                | -15.6       | QP        | 68      | 3.3    | QP (1.00s)                   |



## EMC Test Data

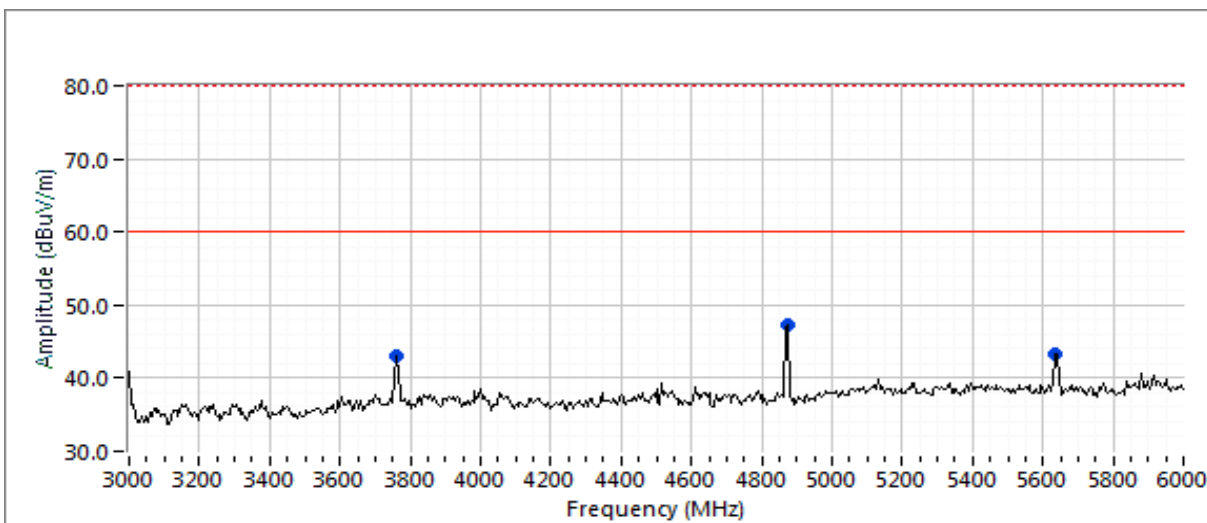
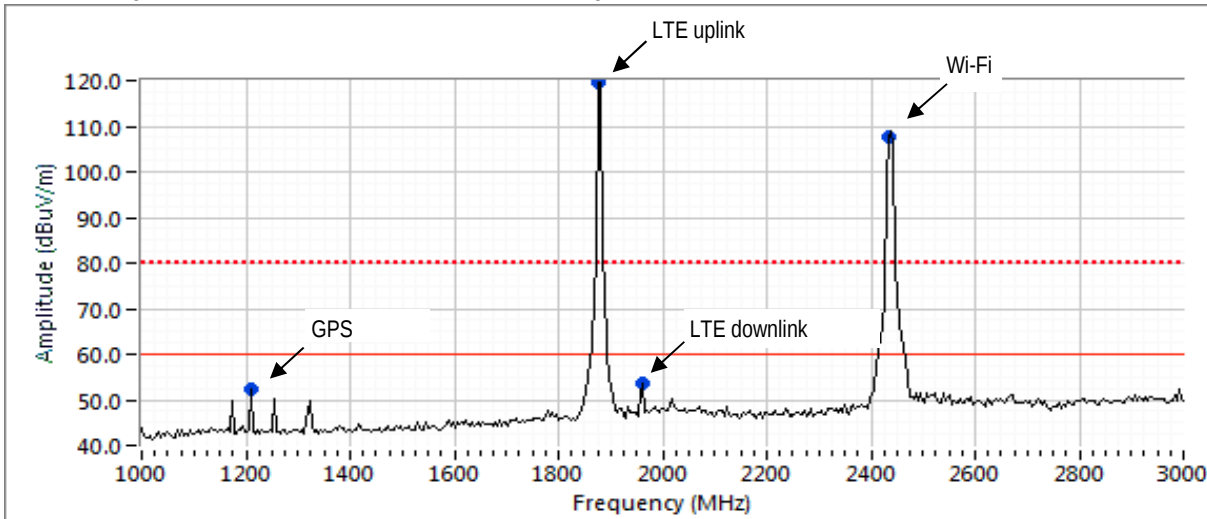
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 26000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 26500                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

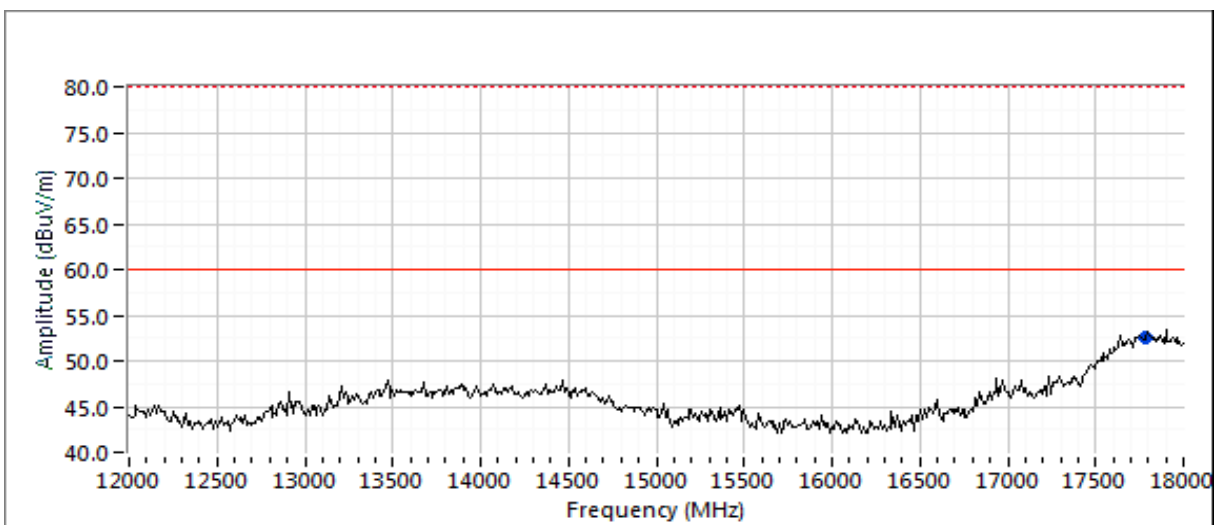
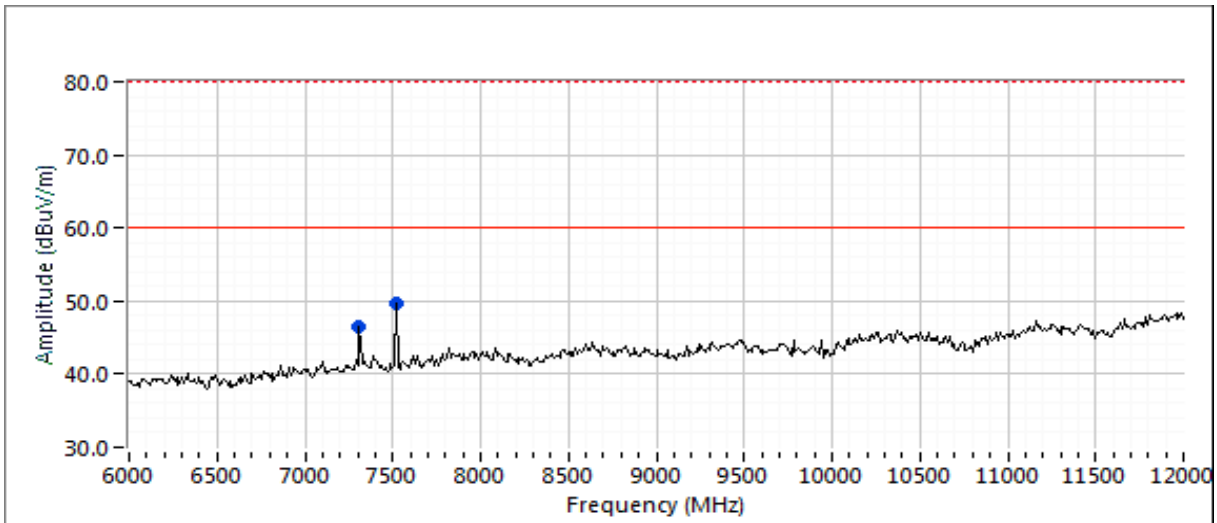
LTE modem (R202) is transmitting at 1880 MHz (Ch# 18900) with max power, 802.11b Ch#6 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

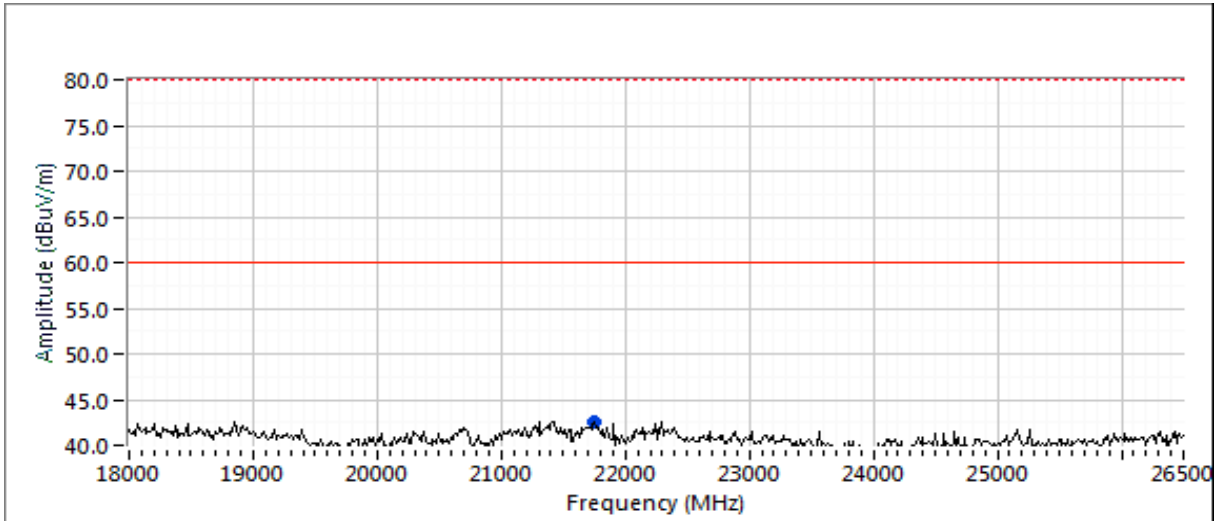
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |



### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments                |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|-------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                         |
| 1218.420  | 52.4         | V   | -                | -      | Peak      | 28      | 1.0    | GPS feed                |
| 1879.960  | 119.6        | V   | -                | -      | Peak      | 57      | 1.0    | LTE Uplink              |
| 1960.220  | 53.5         | V   | -                | -      | Peak      | 230     | 1.0    | LTE downlink            |
| 2436.870  | 107.6        | V   | -                | -      | Peak      | 192     | 1.0    | Wi-Fi                   |
| 3760.000  | 42.9         | V   | -                | -      | Peak      | 288     | 1.3    | LTE Uplink 2nd harmonic |
| 4875.000  | 47.2         | V   | -                | -      | Peak      | 330     | 1.8    | Wi-Fi 2nd harmonic      |
| 5639.700  | 43.2         | H   | -                | -      | Peak      | 95      | 1.8    | LTE Uplink 3rd harmonic |
| 7310.000  | 46.4         | V   | -                | -      | Peak      | 16      | 1.7    | Wi-Fi 3rd harmonic      |
| 7520.000  | 49.6         | V   | -                | -      | Peak      | 124     | 2.0    | LTE Uplink 4th harmonic |
| 17790.000 | 52.6         | H   | -                | -      | Peak      | 221     | 1.8    | Noise floor reading     |
| 21754.170 | 42.6         | V   | -                | -      | Peak      | 302     | 1.2    | Noise floor reading     |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Final readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 24 / 15.247 |             | Detector  | Azimuth | Height | Comments               |
|-----------|--------------|-----|------------------------------------------|-------------|-----------|---------|--------|------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                    | Margin      | Pk/QP/Avg | degrees | meters |                        |
| 3760.400  | 40.6         | V   | 82.2                                     | -41.6       | AVG       | 287     | 1.4    | RB 1 MHz;VB 10 Hz;Peak |
| 3760.270  | 51.3         | V   | 82.2                                     | -30.9       | PK        | 287     | 1.4    | RB 1 MHz;VB 3 MHz;Peak |
| 4874.060  | 47.1         | V   | 54.0                                     | <b>-6.9</b> | AVG       | 329     | 1.1    | RB 1 MHz;VB 1 kHz;Peak |
| 4874.040  | 53.4         | V   | 74.0                                     | -20.6       | PK        | 329     | 1.1    | RB 1 MHz;VB 3 MHz;Peak |
| 5638.110  | 41.7         | H   | 82.2                                     | -40.5       | AVG       | 95      | 1.7    | RB 1 MHz;VB 10 Hz;Peak |
| 5638.530  | 53.0         | H   | 82.2                                     | -29.2       | PK        | 95      | 1.7    | RB 1 MHz;VB 3 MHz;Peak |
| 7310.440  | 45.1         | V   | 54.0                                     | -8.9        | AVG       | 37      | 2.1    | RB 1 MHz;VB 1 kHz;Peak |
| 7310.280  | 54.4         | V   | 74.0                                     | -19.6       | PK        | 37      | 2.1    | RB 1 MHz;VB 3 MHz;Peak |
| 7520.030  | 48.1         | V   | 82.2                                     | -34.1       | AVG       | 122     | 2.0    | RB 1 MHz;VB 10 Hz;Peak |
| 7520.150  | 55.4         | V   | 82.2                                     | -26.8       | PK        | 122     | 2.0    | RB 1 MHz;VB 3 MHz;Peak |

|         |                                                                                                                                                                                                     |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Note 1: | For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB. |
| Note 2: | For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 24 limits apply.<br>For intermodulation emissions, highest emission limit apply.                                     |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 2/27/2020  
Test Engineer: Deniz Demirci  
Test Location: Fremont Chamber #4

Config. Used: 2 (Test plan #2)  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

#### Ambient Conditions:

Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                      | Result | Margin                                 |
|-------|--------------------------------------------------|----------------------------|--------|----------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                    | Eval   | Refer to individual runs               |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                    | Pass   | 33.5 dBμV/m @ 105.73 MHz<br>(-6.5 dB)  |
| 3     | Radiated Emissions<br>1 GHz - 40 GHz Maximized   | FCC Class A<br>FCC Part 27 | Pass   | 55.9 dBμV/m @ 1415.2 MHz<br>(-26.3 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

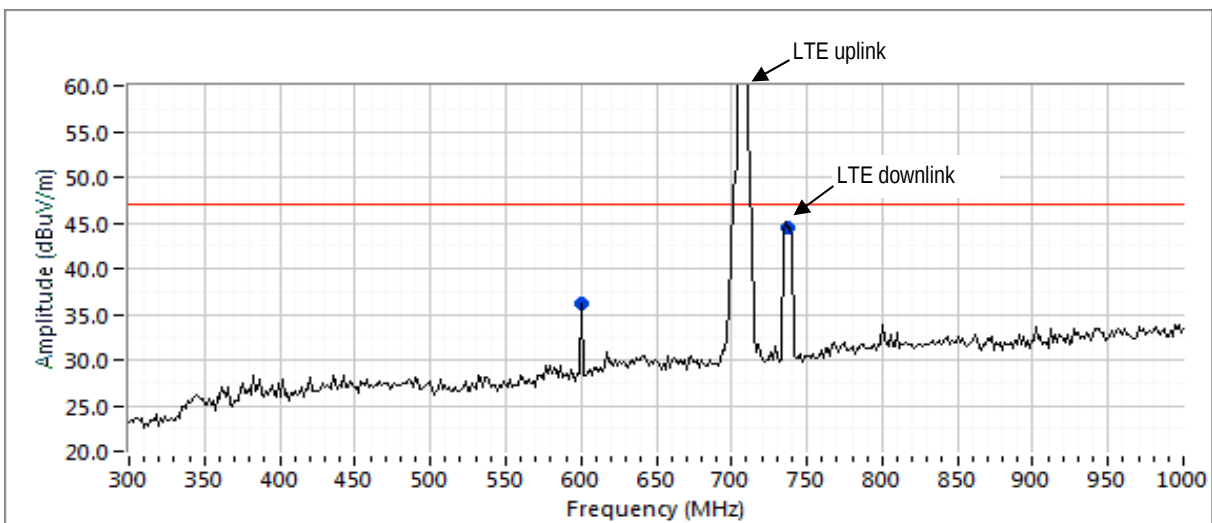
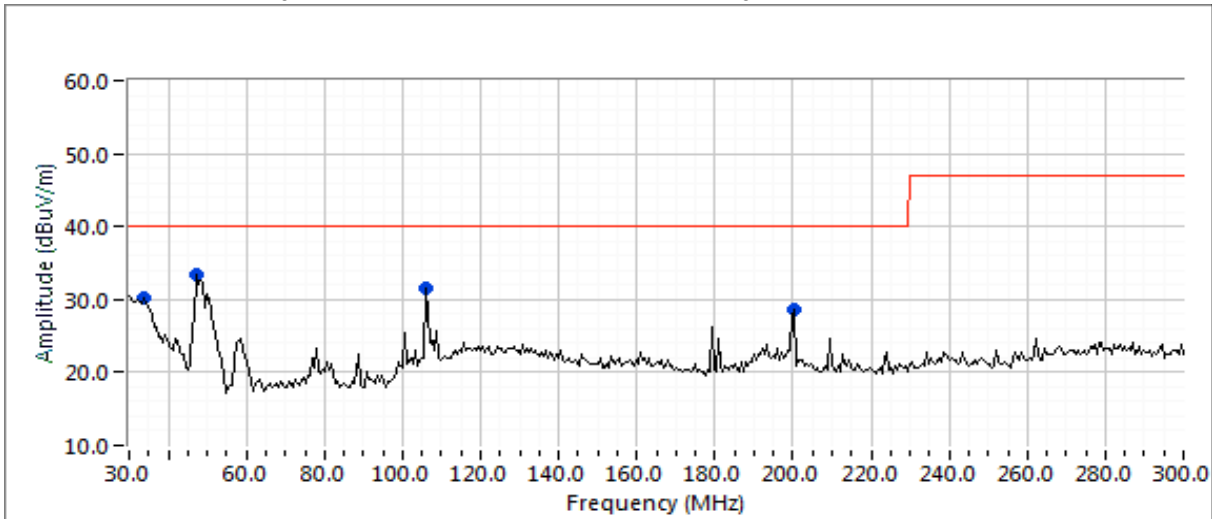
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R202) is transmitting at 707.5 MHz (Ch# 23095) with max power, 802.11n/20 Ch#36 transmitting with max RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments                |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|-------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |                         |
| 33.788    | 30.3         | V   | 40.0                | -9.7   | Peak      | 192     | 1.0    |                         |
| 47.315    | 33.3         | V   | 40.0                | -6.7   | Peak      | 21      | 2.0    |                         |
| 105.752   | 31.5         | H   | 40.0                | -8.5   | Peak      | 289     | 1.5    |                         |
| 200.441   | 28.6         | V   | 40.0                | -11.4  | Peak      | 236     | 1.0    |                         |
| 600.200   | 36.2         | H   | 47.0                | -10.8  | Peak      | 351     | 1.0    |                         |
| 707.519   | 112.2        | H   | -                   | -      | Peak      | 129     | 2.0    | LTE Uplink              |
| 737.575   | 44.5         | H   | -                   | -      | Peak      | 103     | 2.0    | LTE Downlink (Call box) |

### Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |            |
| 33.593    | 25.8         | V   | 40.0                | -14.2  | QP        | 166     | 1.0    | QP (1.00s) |
| 47.675    | 28.2         | V   | 40.0                | -11.8  | QP        | 23      | 1.0    | QP (1.00s) |
| 105.734   | 32.2         | H   | 40.0                | -7.8   | QP        | 285     | 2.0    | QP (1.00s) |
| 199.992   | 23.8         | V   | 40.0                | -16.2  | QP        | 112     | 3.2    | QP (1.00s) |
| 600.001   | 36.7         | H   | 47.0                | -10.3  | QP        | 350     | 1.0    | QP (1.00s) |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                           |                            |                                               |
|------------------------------------------|---------------------------|----------------------------|-----------------------------------------------|
| Frequency Range<br>(MHz)                 | Test Distance<br>(meters) | Limit Distance<br>(meters) | Extrapolation Factor<br>(dB, applied to data) |
| 30 - 1000                                | 5                         | 10                         | -6.0                                          |

### Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency      | Level        | Pol | CISPR 22/32 Class A |             | Detector  | Azimuth | Height | Comments   |
|----------------|--------------|-----|---------------------|-------------|-----------|---------|--------|------------|
| MHz            | dB $\mu$ V/m | v/h | Limit               | Margin      | Pk/QP/Avg | degrees | meters |            |
| <b>105.734</b> | <b>33.5</b>  | H   | 40.0                | <b>-6.5</b> | QP        | 285     | 2.0    | QP (1.00s) |
| 47.675         | 31.2         | V   | 40.0                | -8.8        | QP        | 23      | 1.0    | QP (1.00s) |
| 600.001        | 36.7         | H   | 47.0                | -10.3       | QP        | 350     | 1.0    | QP (1.00s) |
| 33.593         | 28.0         | V   | 40.0                | -12.0       | QP        | 166     | 1.0    | QP (1.00s) |
| 199.992        | 24.3         | V   | 40.0                | -15.7       | QP        | 112     | 3.2    | QP (1.00s) |



## EMC Test Data

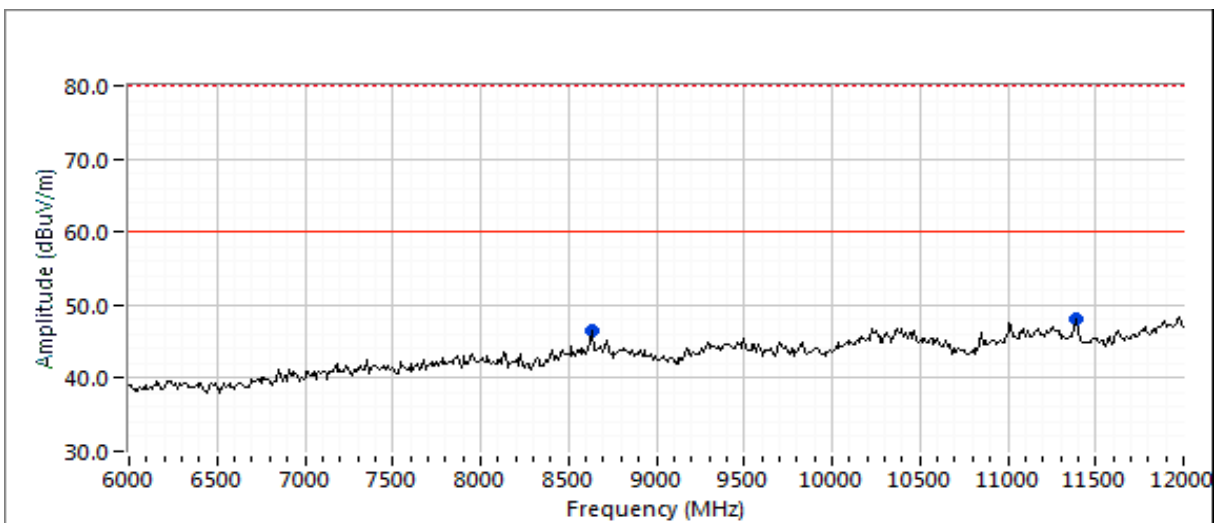
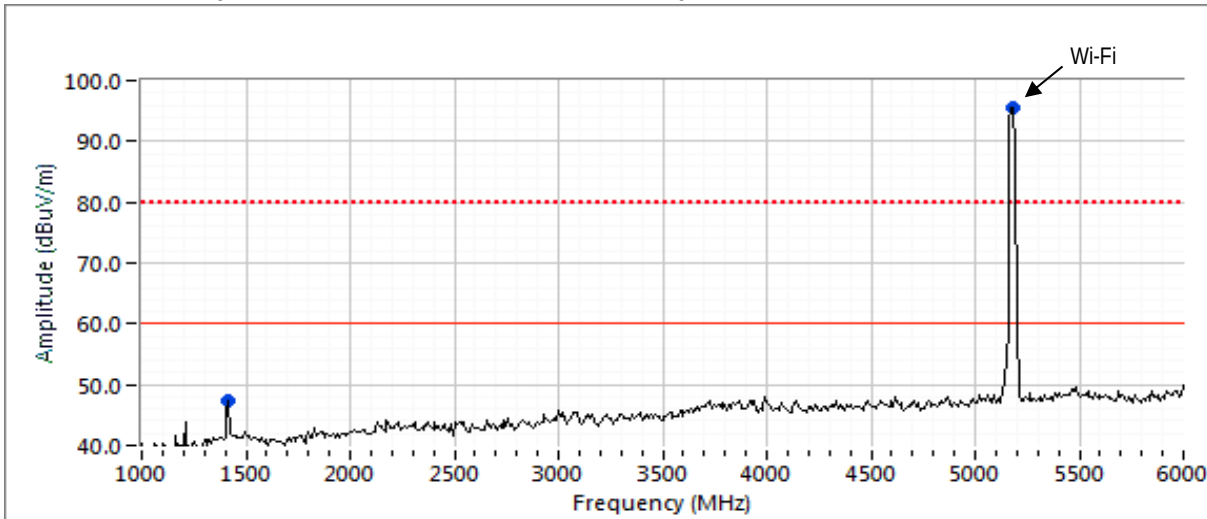
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 40000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 40000                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

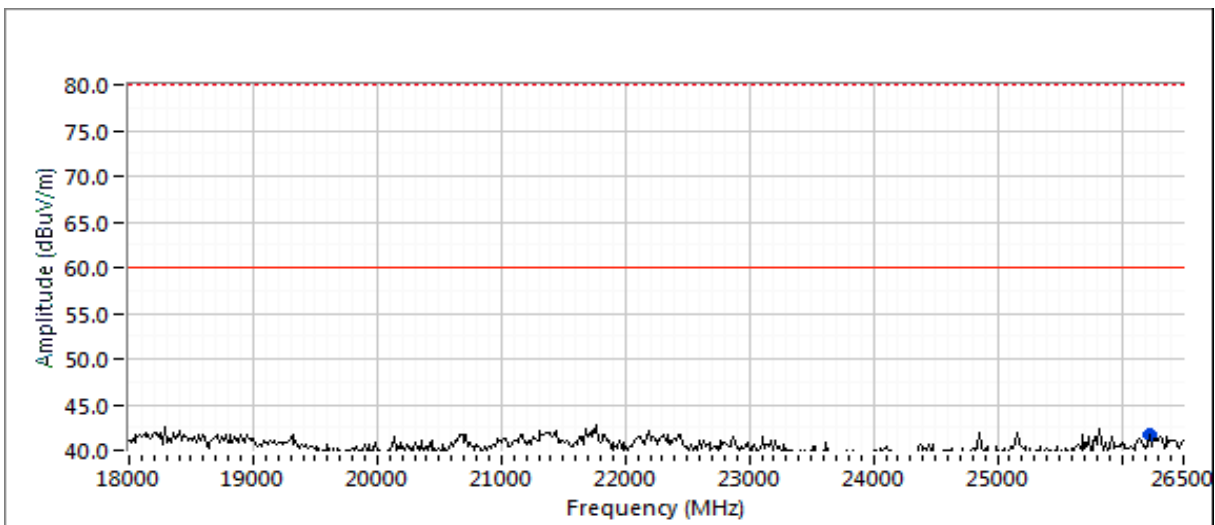
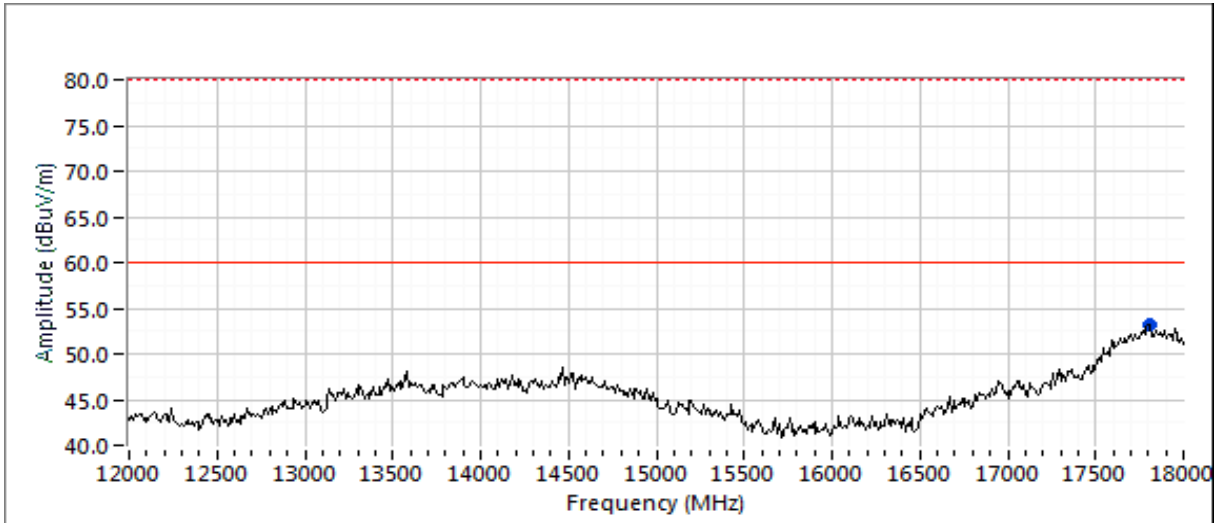
LTE modem (R202) is transmitting at 707.5 MHz (Ch# 23095) with max power, 802.11n20 Ch#36 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

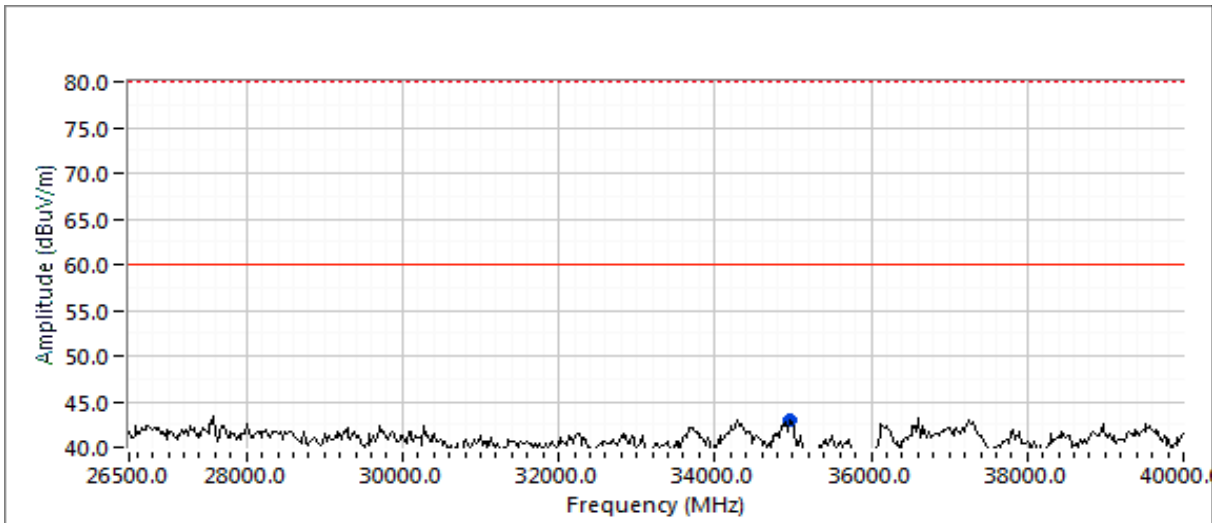
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |



### Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments                |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|-------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                         |
| 1416.670  | 47.3         | H   | -                | -      | Peak      | 308     | 1.8    | LTE Uplink 2nd harmonic |
| 5180.330  | 95.4         | H   | -                | -      | Peak      | 82      | 1.5    | Wi-Fi                   |
| 8630.000  | 46.6         | V   | -                | -      | Peak      | 124     | 2.2    | Noise floor reading     |
| 11390.000 | 48.0         | V   | -                | -      | Peak      | 307     | 2.5    | Noise floor reading     |
| 17810.000 | 53.1         | H   | -                | -      | Peak      | 232     | 1.3    | Noise floor reading     |
| 26230.830 | 41.6         | H   | -                | -      | Peak      | 232     | 2.5    | Noise floor reading     |
| 34960.000 | 42.9         | V   | -                | -      | Peak      | 360     | 2.0    | Noise floor reading     |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Final peak and average readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 24 / 15.247 |        | Detector  | Azimuth | Height | Comments               |
|-----------|--------------|-----|------------------------------------------|--------|-----------|---------|--------|------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                    | Margin | Pk/QP/Avg | degrees | meters |                        |
| 1415.190  | 55.9         | H   | 82.2                                     | -26.3  | PK        | 317     | 1.8    | RB 1 MHz;VB 3 MHz;Peak |
| 1416.610  | 45.0         | H   | 82.2                                     | -37.2  | AVG       | 317     | 1.8    | RB 1 MHz;VB 10 Hz;Peak |

Note 1: For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Note 2: For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply.  
For intermodulation emissions, highest emission limit apply.



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020, 3/5/2020  
Test Engineer: Deniz Demirci  
Test Location: Fremont Chamber #7

Config. Used: 3 (Test plan #3)  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

#### Ambient Conditions:

Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                           | Result | Margin                                 |
|-------|--------------------------------------------------|---------------------------------|--------|----------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                         | Eval   | Refer to individual runs               |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                         | Pass   | 36.4 dBμV/m @ 599.99 MHz<br>(-10.6 dB) |
| 3     | Radiated Emissions<br>1 GHz - 40 GHz Maximized   | FCC Class A<br>FCC Part 15E, 27 | Pass   | 48.1 dBμV/m @ 6930.1 MHz<br>(-34.1 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

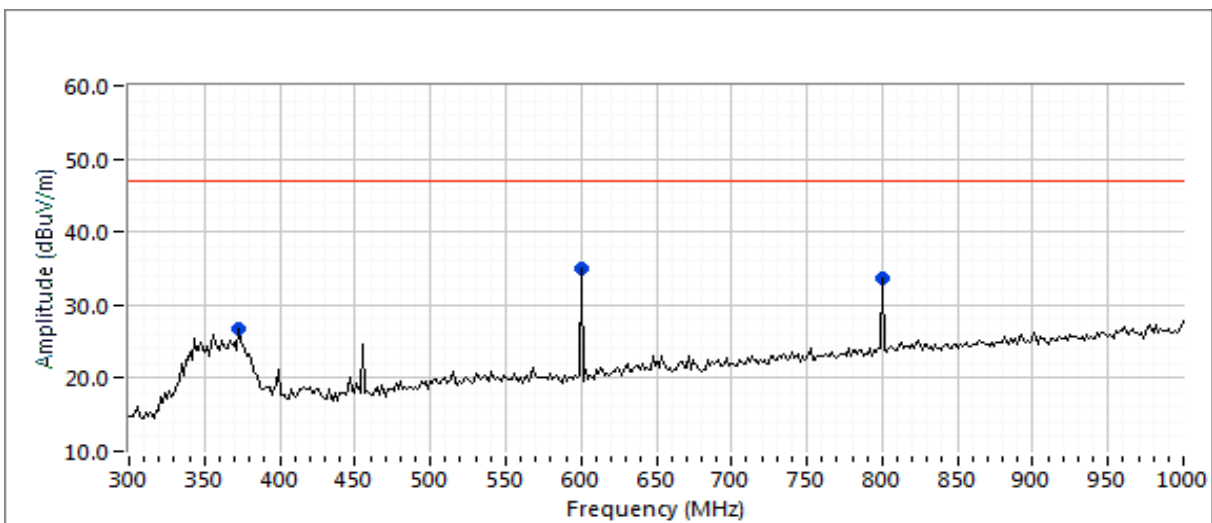
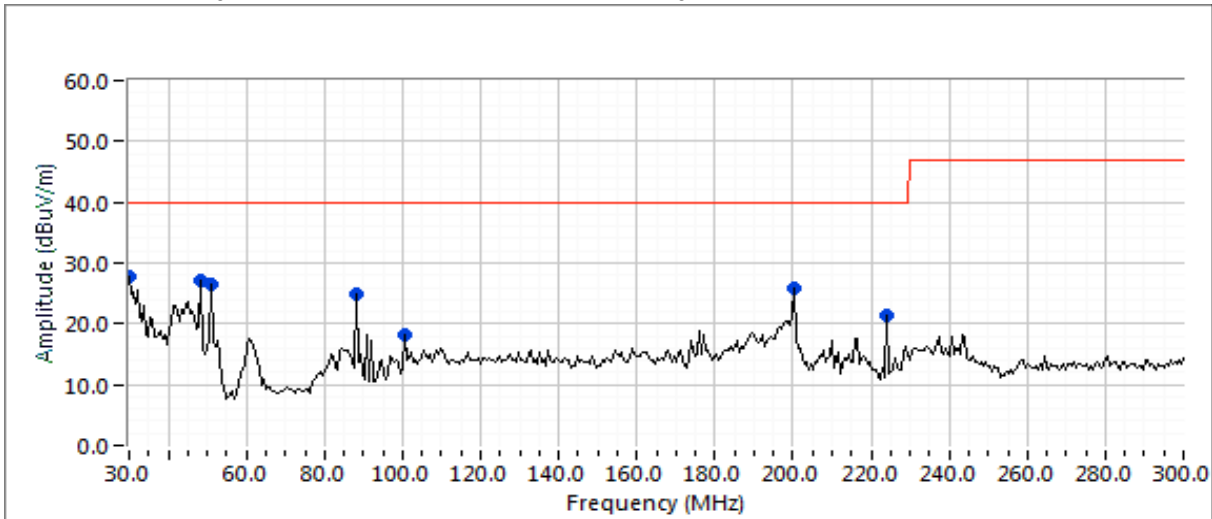
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R202) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11n20 Ch#100 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|----------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |          |
| 30.000    | 27.7         | V   | 40.0                | -12.3  | Peak      | 54      | 1.5    |          |
| 48.397    | 27.0         | V   | 40.0                | -13.0  | Peak      | 228     | 1.5    |          |
| 51.102    | 26.5         | V   | 40.0                | -13.5  | Peak      | 286     | 1.0    |          |
| 88.437    | 25.0         | V   | 40.0                | -15.0  | Peak      | 346     | 4.0    |          |
| 100.341   | 18.1         | V   | 40.0                | -21.9  | Peak      | 276     | 1.0    |          |
| 200.441   | 25.7         | V   | 40.0                | -14.3  | Peak      | 172     | 1.0    |          |
| 224.248   | 21.3         | H   | 40.0                | -18.7  | Peak      | 37      | 2.0    |          |
| 371.543   | 26.5         | H   | 47.0                | -20.5  | Peak      | 48      | 1.0    |          |
| 600.200   | 35.2         | H   | 47.0                | -11.8  | Peak      | 113     | 2.5    |          |
| 800.802   | 31.3         | H   | 47.0                | -15.7  | Peak      | 332     | 1.5    |          |

### Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.114    | 26.0         | V   | 40.0                | -14.0  | QP        | 0       | 1.5    | QP (1.00s) |
| 46.671    | 14.5         | V   | 40.0                | -25.5  | QP        | 0       | 1.5    | QP (1.00s) |
| 48.846    | 13.2         | V   | 40.0                | -26.8  | QP        | 360     | 1.0    | QP (1.00s) |
| 88.507    | 25.0         | V   | 40.0                | -15.0  | QP        | 360     | 4.0    | QP (1.00s) |
| 100.271   | 19.4         | V   | 40.0                | -20.6  | QP        | 276     | 1.0    | QP (1.00s) |
| 200.003   | 25.2         | V   | 40.0                | -14.8  | QP        | 172     | 1.0    | QP (1.00s) |
| 224.005   | 22.4         | H   | 40.0                | -17.6  | QP        | 43      | 1.9    | QP (1.00s) |
| 370.856   | 23.9         | H   | 47.0                | -23.1  | QP        | 48      | 1.0    | QP (1.00s) |
| 599.990   | 36.4         | H   | 47.0                | -10.6  | QP        | 114     | 2.3    | QP (1.00s) |
| 800.002   | 31.7         | H   | 47.0                | -15.3  | QP        | 248     | 1.6    | QP (1.00s) |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                           |                            |                                               |
|------------------------------------------|---------------------------|----------------------------|-----------------------------------------------|
| Frequency Range<br>(MHz)                 | Test Distance<br>(meters) | Limit Distance<br>(meters) | Extrapolation Factor<br>(dB, applied to data) |
| 30 - 1000                                | 5                         | 10                         | -6.0                                          |

### Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |            |
| 599.990   | 36.4         | H   | 47.0                | -10.6  | QP        | 114     | 2.3    | QP (1.00s) |
| 48.846    | 29.3         | V   | 40.0                | -10.7  | QP        | 360     | 1.0    | QP (1.00s) |
| 200.003   | 26.4         | V   | 40.0                | -13.6  | QP        | 172     | 1.0    | QP (1.00s) |
| 30.114    | 26.0         | V   | 40.0                | -14.0  | QP        | 0       | 1.5    | QP (1.00s) |
| 88.507    | 25.0         | V   | 40.0                | -15.0  | QP        | 360     | 4.0    | QP (1.00s) |
| 800.002   | 31.7         | H   | 47.0                | -15.3  | QP        | 248     | 1.6    | QP (1.00s) |
| 224.005   | 22.4         | H   | 40.0                | -17.6  | QP        | 43      | 1.9    | QP (1.00s) |
| 100.271   | 19.4         | V   | 40.0                | -20.6  | QP        | 276     | 1.0    | QP (1.00s) |



## EMC Test Data

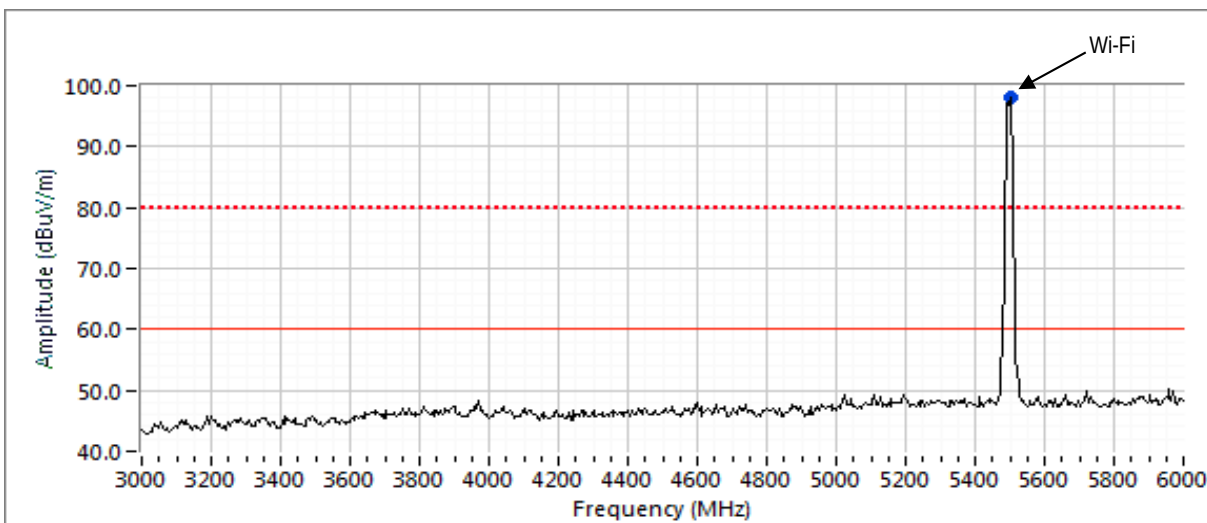
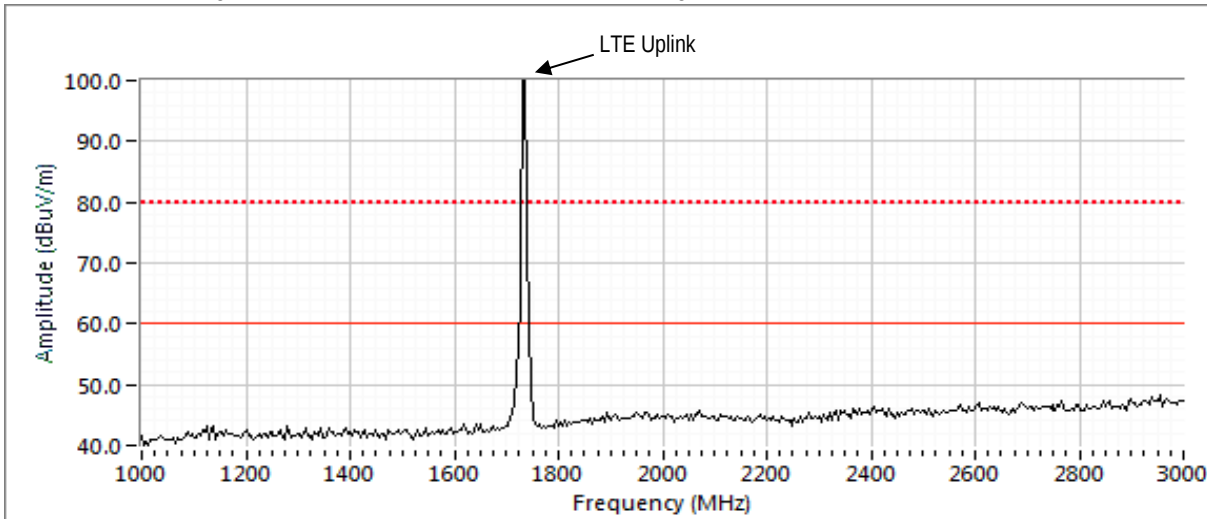
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 40000 MHz

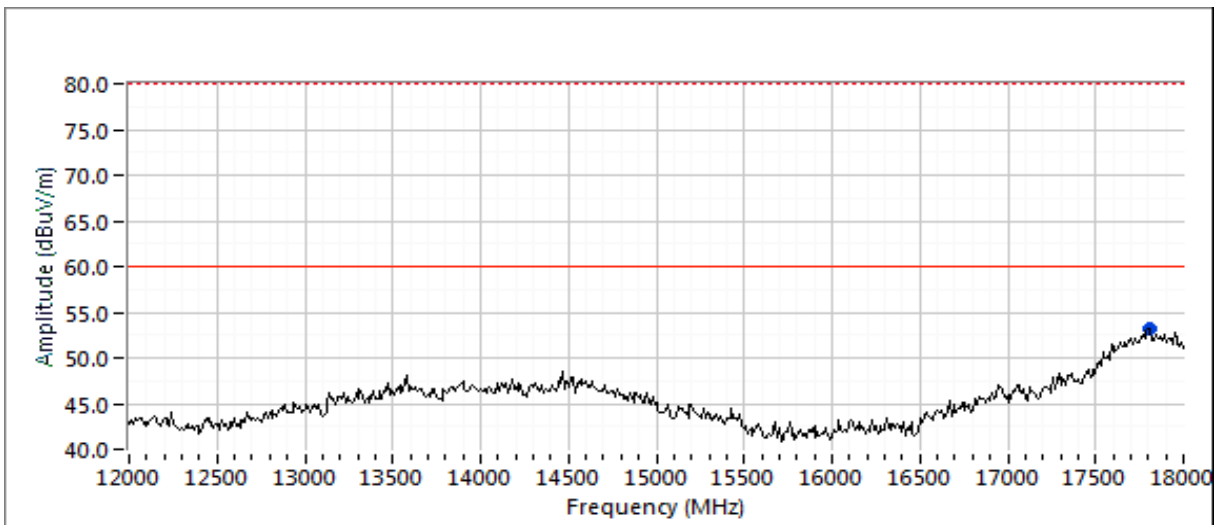
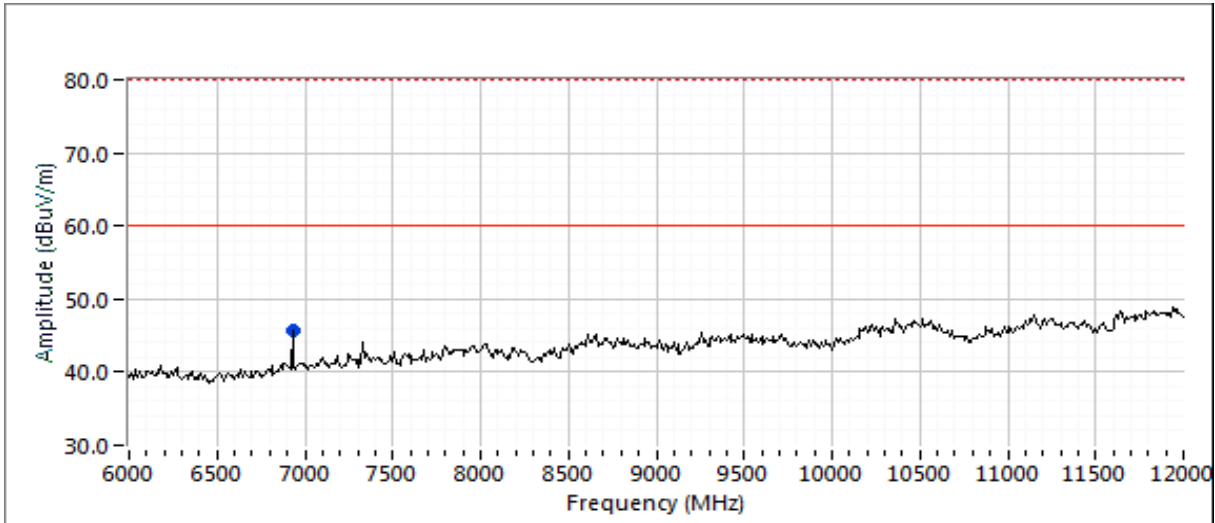
| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 40000                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

LTE modem (R202) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11n20 Ch#100 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



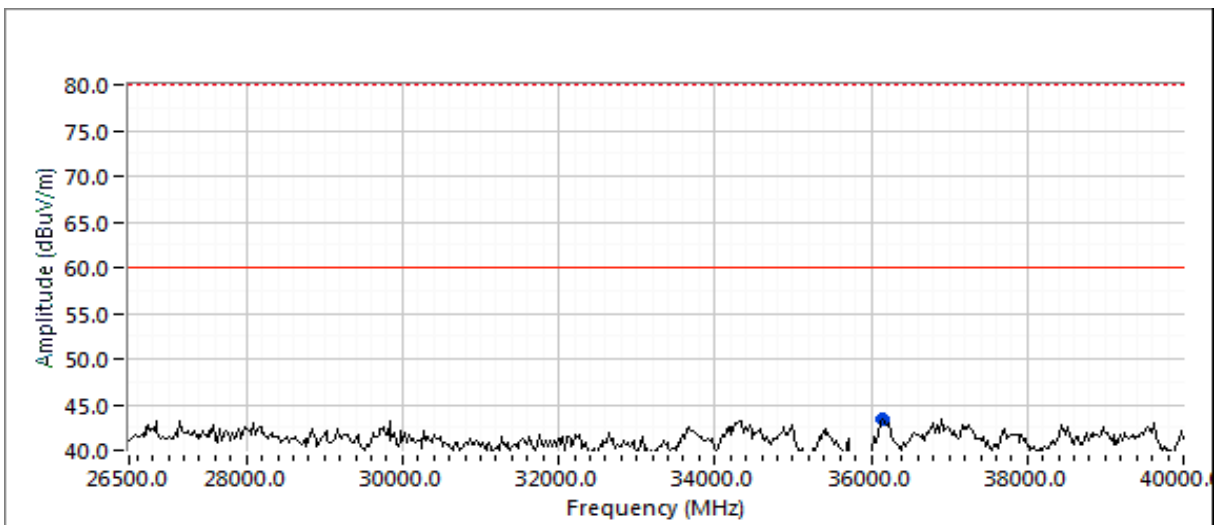
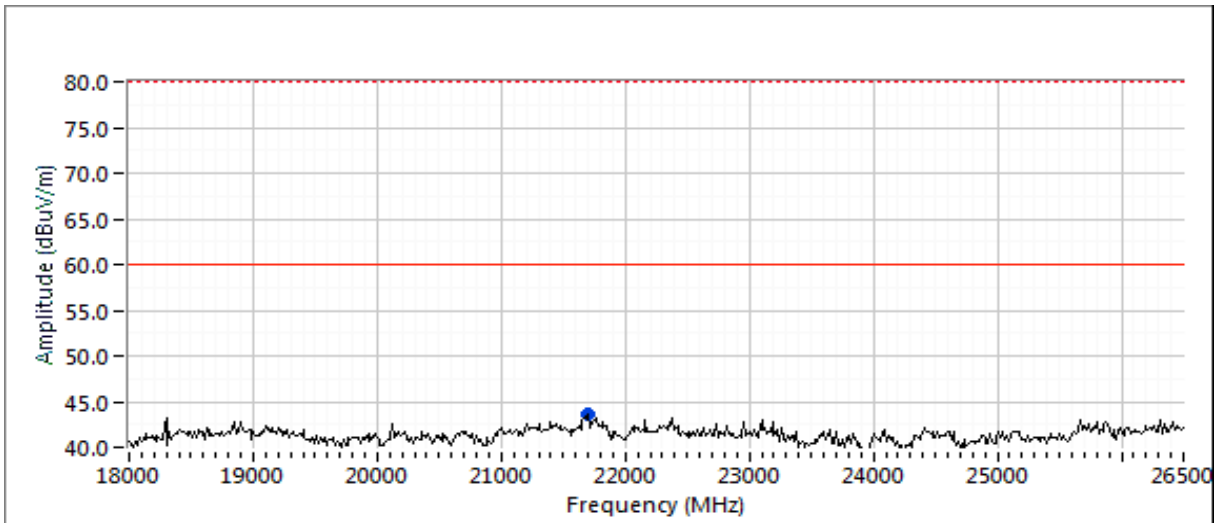
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments            |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|---------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                     |
| 1732.460  | 107.5        | V   | -                | -      | Peak      | 154     | 1.0    | LTE                 |
| 5500.000  | 98.2         | V   | -                | -      | Peak      | 285     | 1.5    | Wi-Fi               |
| 6930.000  | 45.8         | V   | 60.0             | -14.2  | Peak      | 191     | 1.5    | LTE 4th harmonic.   |
| 17820.000 | 48.3         | H   | -                | -      | Peak      | 215     | 1.0    | Noise floor reading |
| 21697.500 | 43.7         | V   | -                | -      | Peak      | 128     | 1.0    | Noise floor reading |
| 36152.500 | 43.4         | V   | -                | -      | Peak      | 222     | 1.3    | Noise floor reading |

### Final peak and average readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 27 / 15E |        | Detector  | Azimuth | Height | Comments                 |
|-----------|--------------|-----|---------------------------------------|--------|-----------|---------|--------|--------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                 | Margin | Pk/QP/Avg | degrees | meters |                          |
| 6930.070  | 48.1         | V   | 82.2                                  | -34.1  | Sample    | 194     | 1.6    | RB 1 MHz;VB 3 MHz;Sample |

Note 1: For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Note 2: For Wi-Fi harmonics, FCC Part 15E limits apply. For LTE harmonics, FCC Part 27 limits apply.  
For intermodulation emissions, highest emission limit apply.



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020, 3/5/2020  
Test Engineer: Deniz Demirci  
Test Location: Fremont Chamber #7

Config. Used: 4 (Test plan #4)  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

#### Ambient Conditions:

Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                           | Result | Margin                                 |
|-------|--------------------------------------------------|---------------------------------|--------|----------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                         | Eval   | Refer to individual runs               |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                         | Pass   | 36.8 dBμV/m @ 599.99 MHz<br>(-10.2 dB) |
| 3     | Radiated Emissions<br>1 GHz - 40 GHz Maximized   | FCC Class A<br>FCC Part 15E, 22 | Pass   | 62.1 dBμV/m @ 17475.4 MHz<br>(-6.1 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

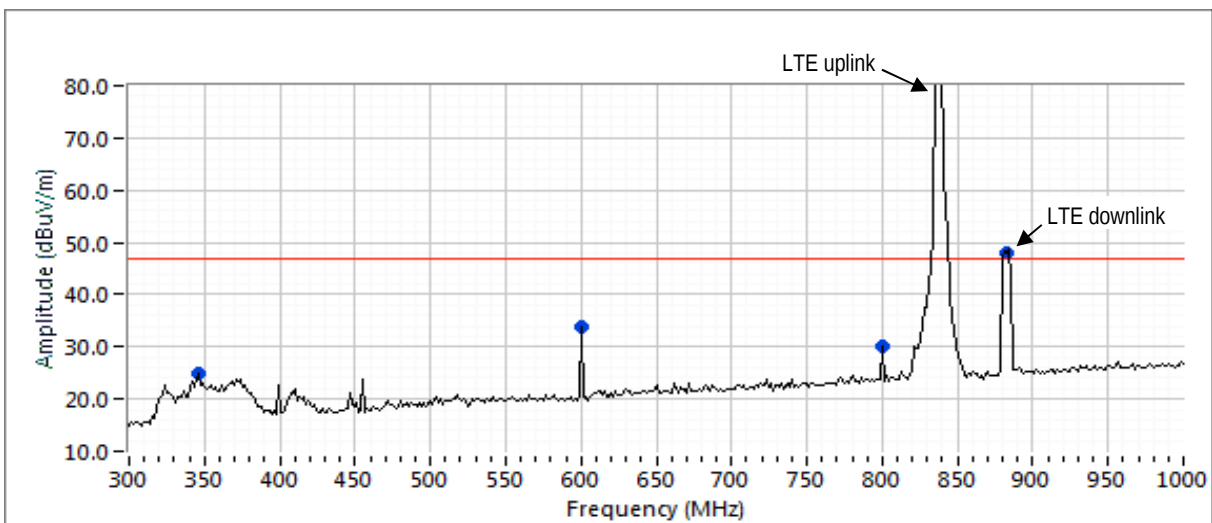
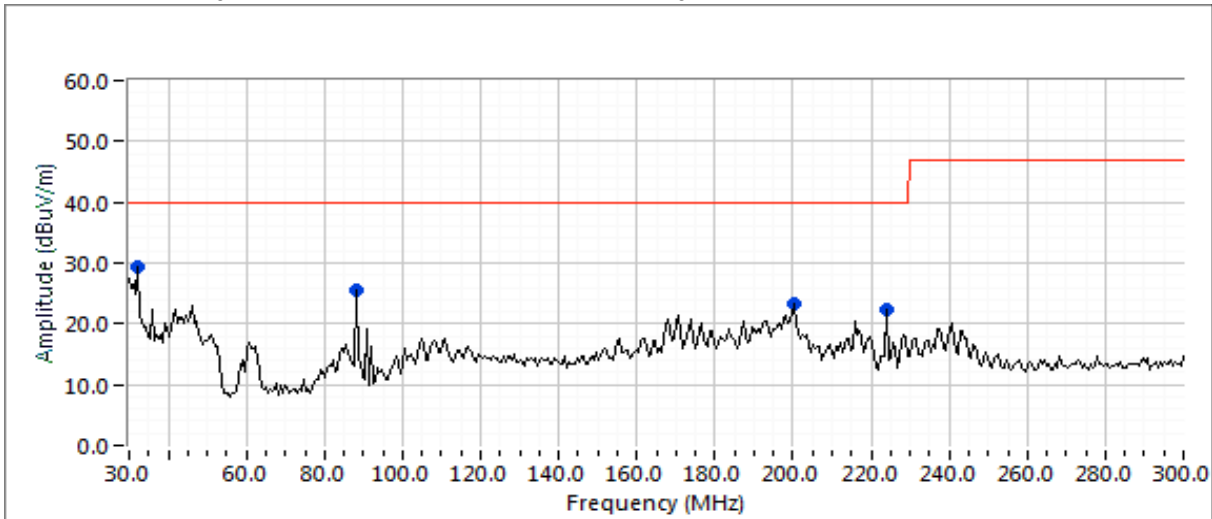
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R202) is transmitting at 836.5 MHz (Ch# 20525) with max power, 802.11n20 Ch#165 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments     |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|--------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |              |
| 32.164    | 29.5         | V   | 40.0                | -10.5  | Peak      | 239     | 3.0    |              |
| 88.437    | 25.6         | V   | 40.0                | -14.4  | Peak      | 346     | 4.0    |              |
| 200.441   | 23.2         | H   | 40.0                | -16.8  | Peak      | 44      | 2.0    |              |
| 224.248   | 22.3         | H   | 40.0                | -17.7  | Peak      | 48      | 1.5    |              |
| 346.293   | 24.9         | H   | 47.0                | -22.1  | Peak      | 47      | 1.0    |              |
| 600.200   | 33.8         | H   | 47.0                | -13.2  | Peak      | 130     | 1.0    |              |
| 800.802   | 30.2         | V   | 47.0                | -16.8  | Peak      | 184     | 2.5    |              |
| 836.577   | 87.5         | H   | -                   | -      | Peak      | 184     | 3.0    | LTE uplink   |
| 881.502   | 48.1         | H   | -                   | -      | Peak      | 75      | 1.5    | LTE downlink |

### Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 22/32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|---------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit               | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.088    | 26.7         | V   | 40.0                | -13.3  | QP        | 180     | 1.1    | QP (1.00s) |
| 88.507    | 24.3         | V   | 40.0                | -15.7  | QP        | 360     | 4.0    | QP (1.00s) |
| 200.003   | 25.3         | H   | 40.0                | -14.7  | QP        | 49      | 2.6    | QP (1.00s) |
| 224.005   | 23.3         | H   | 40.0                | -16.7  | QP        | 49      | 2.0    | QP (1.00s) |
| 350.487   | 22.6         | H   | 47.0                | -24.4  | QP        | 50      | 4.0    | QP (1.00s) |
| 599.990   | 36.7         | H   | 47.0                | -10.3  | QP        | 130     | 1.0    | QP (1.00s) |
| 800.002   | 32.1         | V   | 47.0                | -14.9  | QP        | 139     | 1.0    | QP (1.00s) |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                           |                            |                                               |
|------------------------------------------|---------------------------|----------------------------|-----------------------------------------------|
| Frequency Range<br>(MHz)                 | Test Distance<br>(meters) | Limit Distance<br>(meters) | Extrapolation Factor<br>(dB, applied to data) |
| 30 - 1000                                | 5                         | 10                         | -6.0                                          |

### Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency      | Level        | Pol | CISPR 22/32 Class A |              | Detector  | Azimuth | Height | Comments   |
|----------------|--------------|-----|---------------------|--------------|-----------|---------|--------|------------|
| MHz            | dB $\mu$ V/m | v/h | Limit               | Margin       | Pk/QP/Avg | degrees | meters |            |
| <b>599.990</b> | <b>36.8</b>  | H   | 47.0                | <b>-10.2</b> | QP        | 130     | 1.0    | QP (1.00s) |
| 30.088         | 26.7         | V   | 40.0                | -13.3        | QP        | 180     | 1.1    | QP (1.00s) |
| 800.002        | 32.7         | V   | 47.0                | -14.3        | QP        | 139     | 1.0    | QP (1.00s) |
| 200.003        | 25.3         | H   | 40.0                | -14.7        | QP        | 49      | 2.6    | QP (1.00s) |
| 88.507         | 24.3         | V   | 40.0                | -15.7        | QP        | 360     | 4.0    | QP (1.00s) |
| 224.005        | 23.3         | H   | 40.0                | -16.7        | QP        | 49      | 2.0    | QP (1.00s) |
| 350.487        | 22.6         | H   | 47.0                | -24.4        | QP        | 50      | 4.0    | QP (1.00s) |



## EMC Test Data

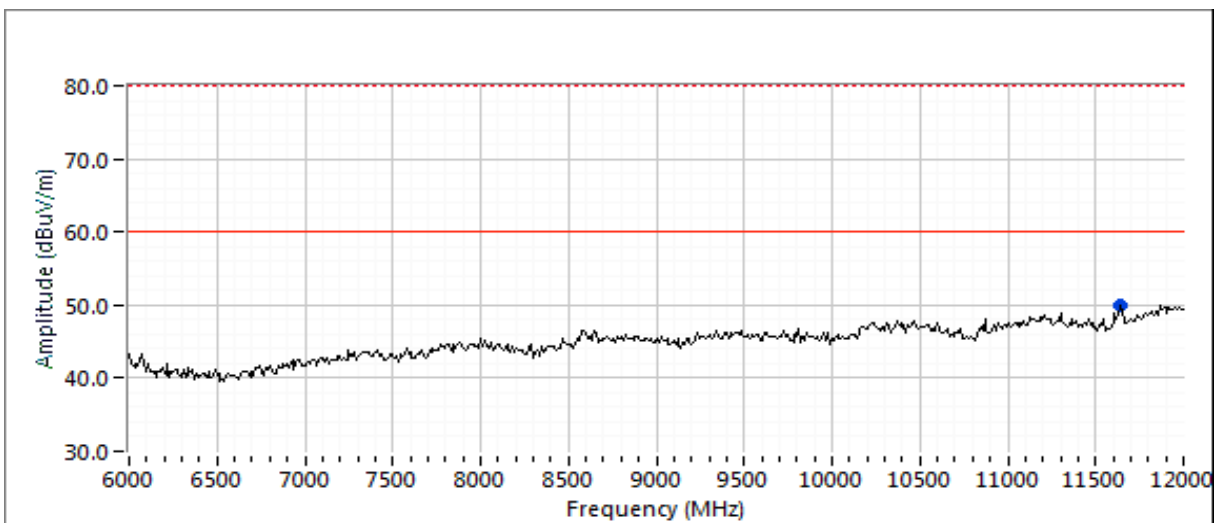
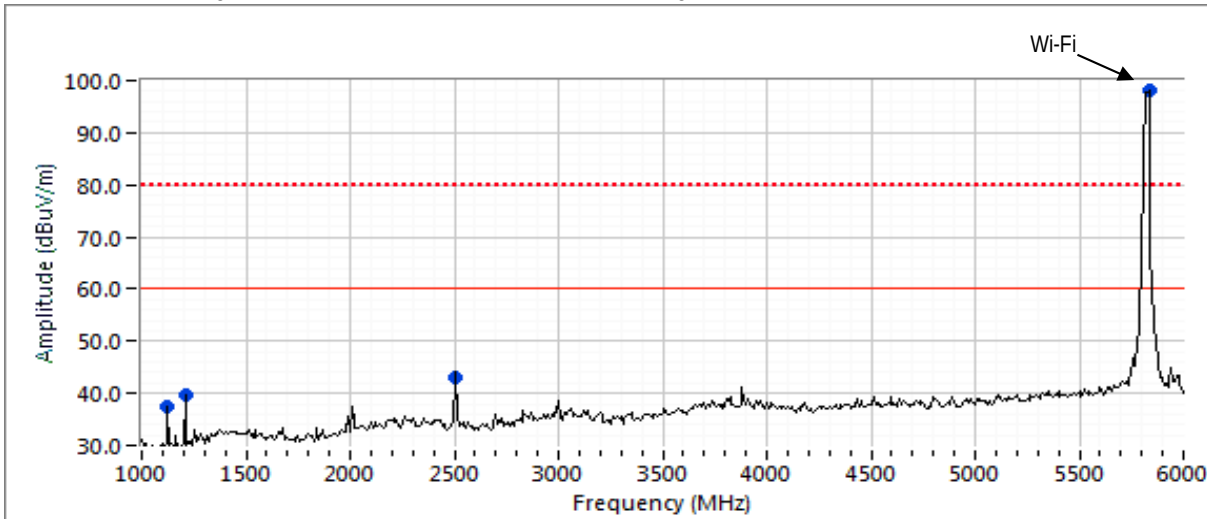
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 40000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 40000                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

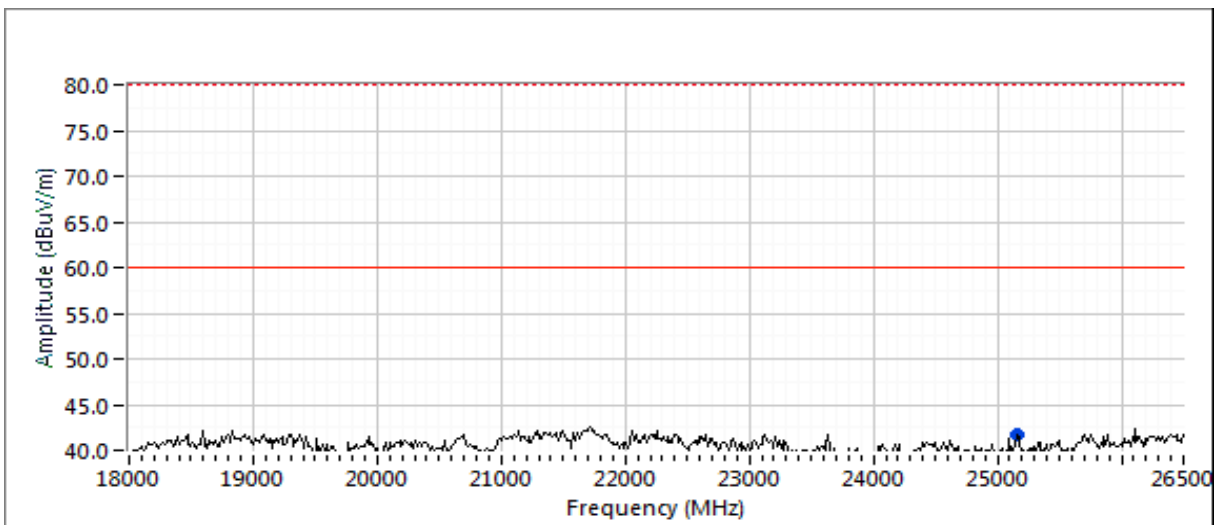
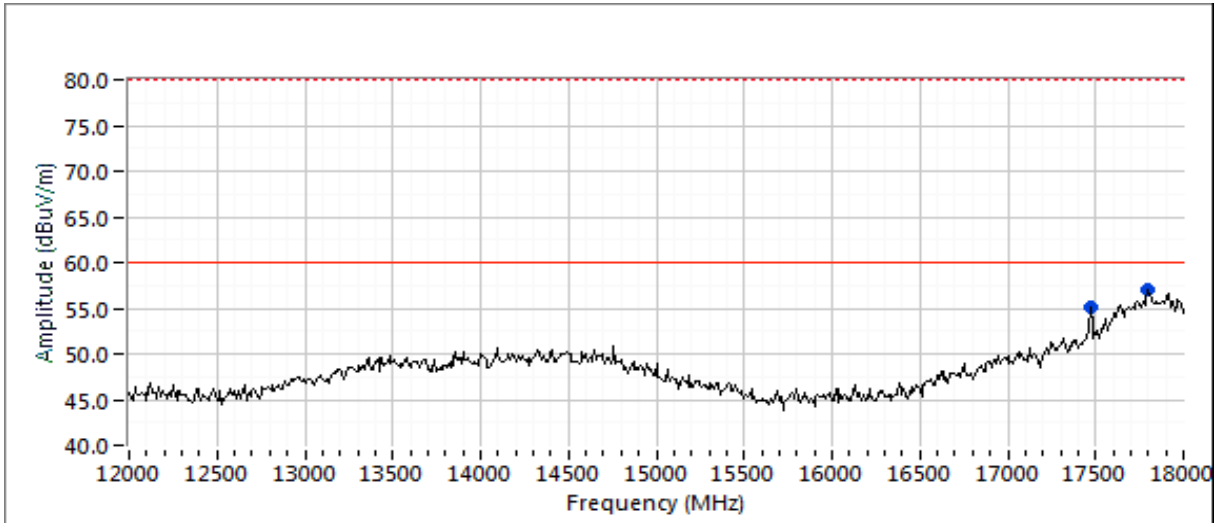
LTE modem (R202) is transmitting at 836.5 MHz (Ch# 20525) with max power, 802.11n20 Ch#165 transmitting with max RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

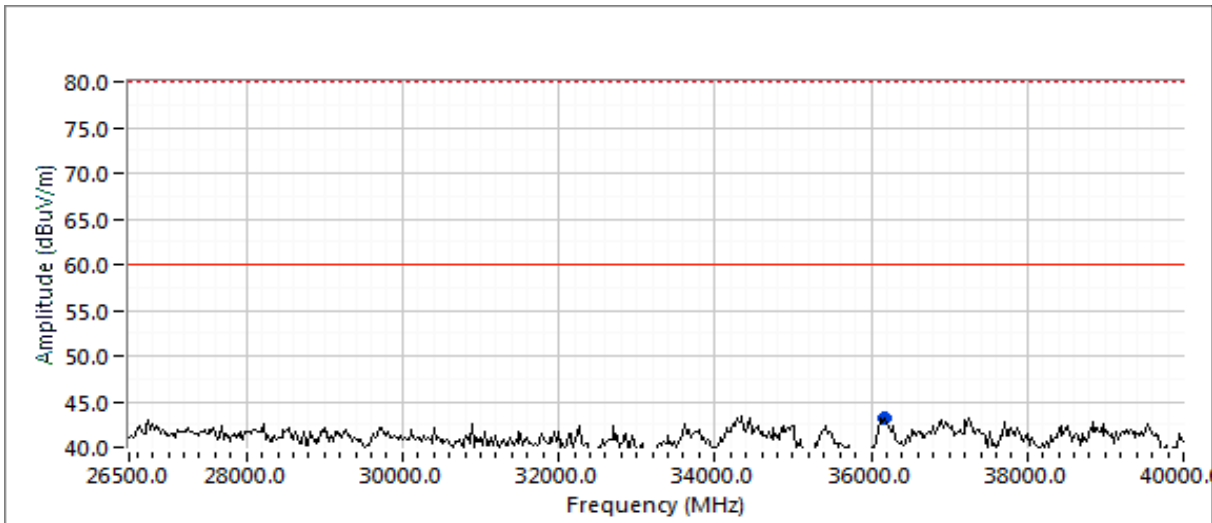
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |



### Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments            |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|---------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                     |
| 1125.000  | 37.3         | V   | 60.0             | -22.7  | Peak      | 158     | 2.5    |                     |
| 1208.330  | 39.7         | V   | 60.0             | -20.3  | Peak      | 90      | 1.3    |                     |
| 2500.000  | 42.9         | V   | 60.0             | -17.1  | Peak      | 36      | 1.8    |                     |
| 5833.330  | 98.0         | V   | -                | -      | Peak      | 72      | 1.5    | Wi-Fi               |
| 11666.000 | 49.9         | H   | -                | -      | Peak      | 282     | 1.5    | Wi-Fi 2nd harmonic  |
| 17496.000 | 55.2         | V   | -                | -      | Peak      | 93      | 1.3    | Wi-Fi 3rd harmonic  |
| 17800.000 | 57.0         | H   | -                | -      | Peak      | 86      | 2.0    | Noise floor reading |
| 25154.170 | 41.7         | H   | -                | -      | Peak      | 121     | 2.0    | Noise floor reading |
| 36175.000 | 43.2         | H   | -                | -      | Peak      | 354     | 2.3    | Noise floor reading |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Final peak and average readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 22 / 15E |        | Detector  | Azimuth | Height | Comments               |
|-----------|--------------|-----|---------------------------------------|--------|-----------|---------|--------|------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                 | Margin | Pk/QP/Avg | degrees | meters |                        |
| 17475.380 | 62.1         | V   | 68.2                                  | -6.1   | PK        | 114     | 1.6    | RB 1 MHz;VB 3 MHz;Peak |
| 11655.200 | 55.6         | H   | 68.2                                  | -12.6  | PK        | 282     | 1.5    | RB 1 MHz;VB 3 MHz;Peak |

Note 1: For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Note 2: For Wi-Fi harmonics, FCC Part 15E limits apply. For LTE harmonics, FCC Part 22 limits apply.  
For intermodulation emissions, highest emission limit apply.



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/2/2020, 3/6/2020  
Test Engineer: John Caizzi  
Test Location: Fremont Chamber #4

Config. Used: 5 (Test plan #5)  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

#### Ambient Conditions:

Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                              | Result | Margin                                |
|-------|--------------------------------------------------|------------------------------------|--------|---------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                            | Eval   | Refer to individual runs              |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                            | Pass   | 38.9 dBμV/m @ 599.99 MHz<br>(-8.1 dB) |
| 3     | Radiated Emissions<br>1 GHz - 25 GHz Maximized   | FCC Class A<br>FCC Part 27, 15.247 | Pass   | 46.6 dBμV/m @ 4824.0 MHz<br>(-7.4 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

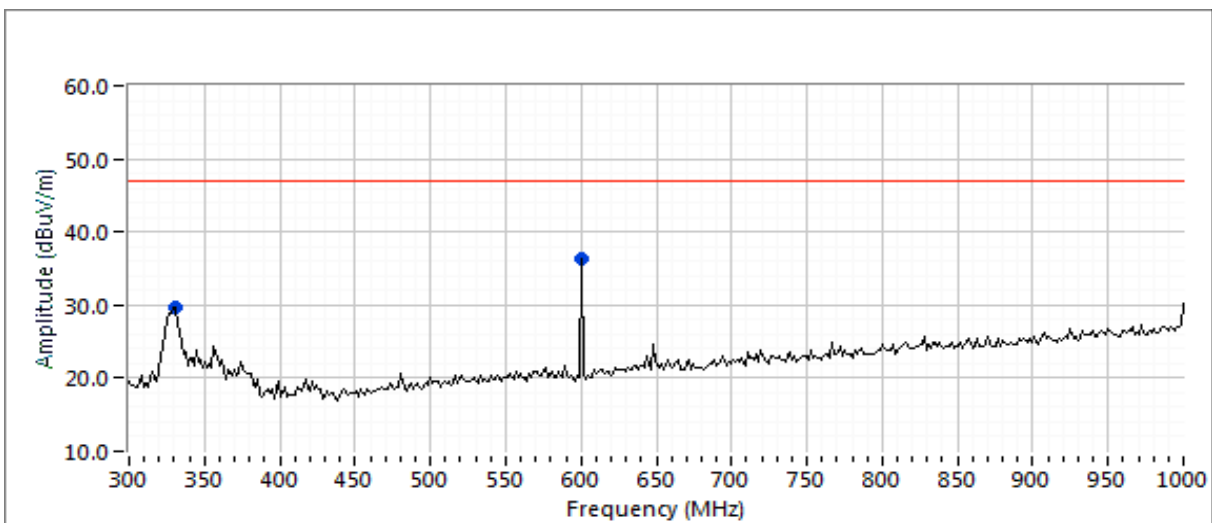
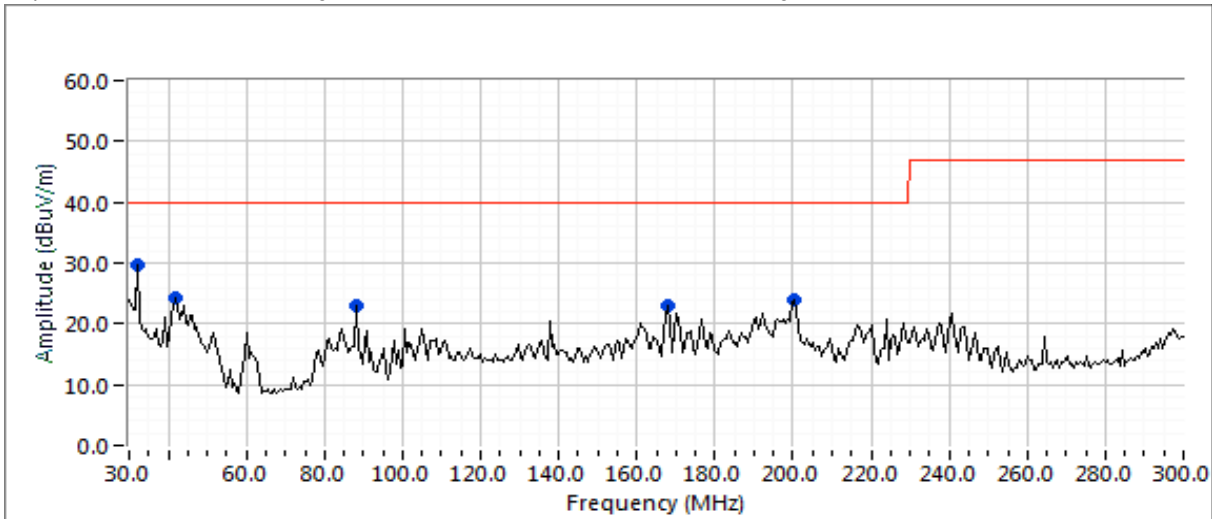
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R204) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11b Ch#1 transmitting with max rated RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





# EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

## Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|----------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |          |
| 32.164    | 29.6         | V   | 40.0             | -10.4  | Peak      | 64      | 2.5    |          |
| 41.904    | 24.4         | V   | 40.0             | -15.6  | Peak      | 74      | 1.0    |          |
| 88.437    | 23.0         | V   | 40.0             | -17.0  | Peak      | 332     | 4.0    |          |
| 167.976   | 23.0         | V   | 40.0             | -17.0  | Peak      | 228     | 1.0    |          |
| 200.441   | 23.9         | V   | 40.0             | -16.1  | Peak      | 174     | 1.0    |          |
| 330.862   | 29.8         | H   | 47.0             | -17.2  | Peak      | 52      | 1.5    |          |
| 600.200   | 36.2         | H   | 47.0             | -10.8  | Peak      | 5       | 3.0    |          |

## Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.604    | 25.8         | V   | 40.0             | -14.2  | QP        | 0       | 1.0    | QP (1.00s) |
| 41.520    | 21.1         | V   | 40.0             | -18.9  | QP        | 0       | 1.0    | QP (1.00s) |
| 88.507    | 22.6         | V   | 40.0             | -17.4  | QP        | 332     | 4.0    | QP (1.00s) |
| 167.992   | 21.6         | V   | 40.0             | -18.4  | QP        | 212     | 1.0    | QP (1.00s) |
| 200.022   | 24.6         | V   | 40.0             | -15.4  | QP        | 180     | 1.0    | QP (1.00s) |
| 329.389   | 27.3         | H   | 47.0             | -19.7  | QP        | 52      | 1.5    | QP (1.00s) |
| 599.994   | 38.9         | H   | 47.0             | -8.1   | QP        | 6       | 3.0    | QP (1.00s) |

## Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                        |                         |                                            |
|------------------------------------------|------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                    | Test Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                                | 5                      | 10                      | -6.0                                       |

## Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.604    | 25.8         | V   | 40.0             | -14.2  | QP        | 0       | 1.0    | QP (1.00s) |
| 41.520    | 21.1         | V   | 40.0             | -18.9  | QP        | 0       | 1.0    | QP (1.00s) |
| 88.507    | 22.6         | V   | 40.0             | -17.4  | QP        | 332     | 4.0    | QP (1.00s) |
| 167.992   | 21.6         | V   | 40.0             | -18.4  | QP        | 212     | 1.0    | QP (1.00s) |
| 200.022   | 24.6         | V   | 40.0             | -15.4  | QP        | 180     | 1.0    | QP (1.00s) |
| 329.389   | 27.3         | H   | 47.0             | -19.7  | QP        | 52      | 1.5    | QP (1.00s) |
| 599.994   | 38.9         | H   | 47.0             | -8.1   | QP        | 6       | 3.0    | QP (1.00s) |



## EMC Test Data

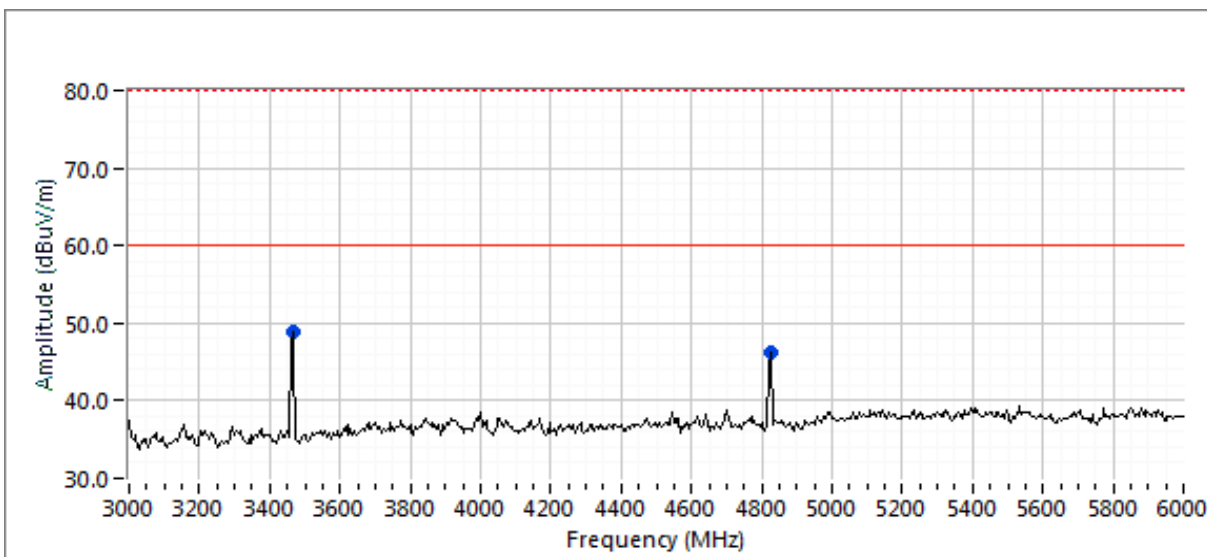
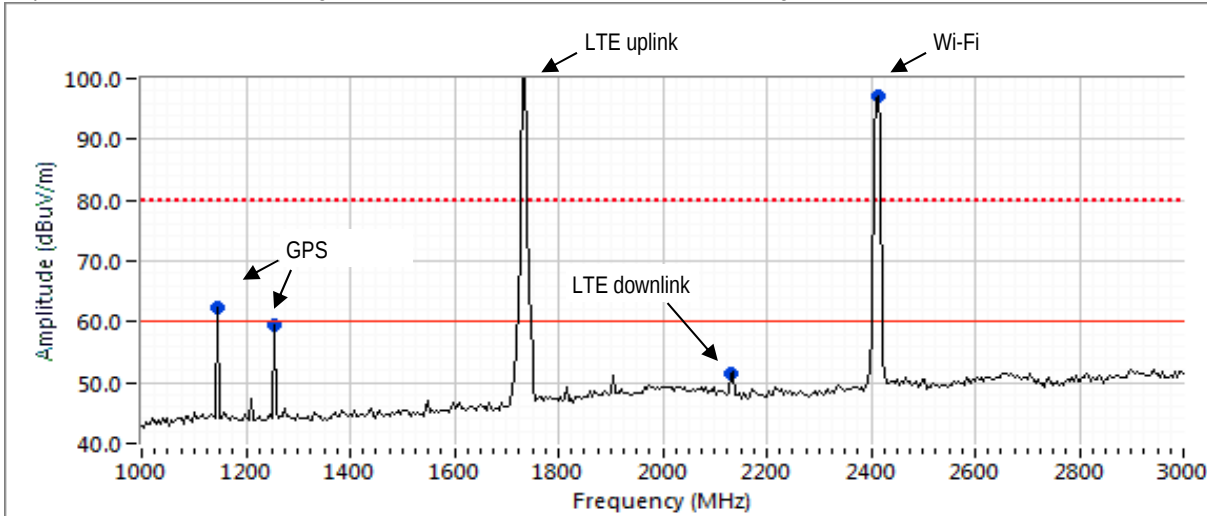
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 25000 MHz

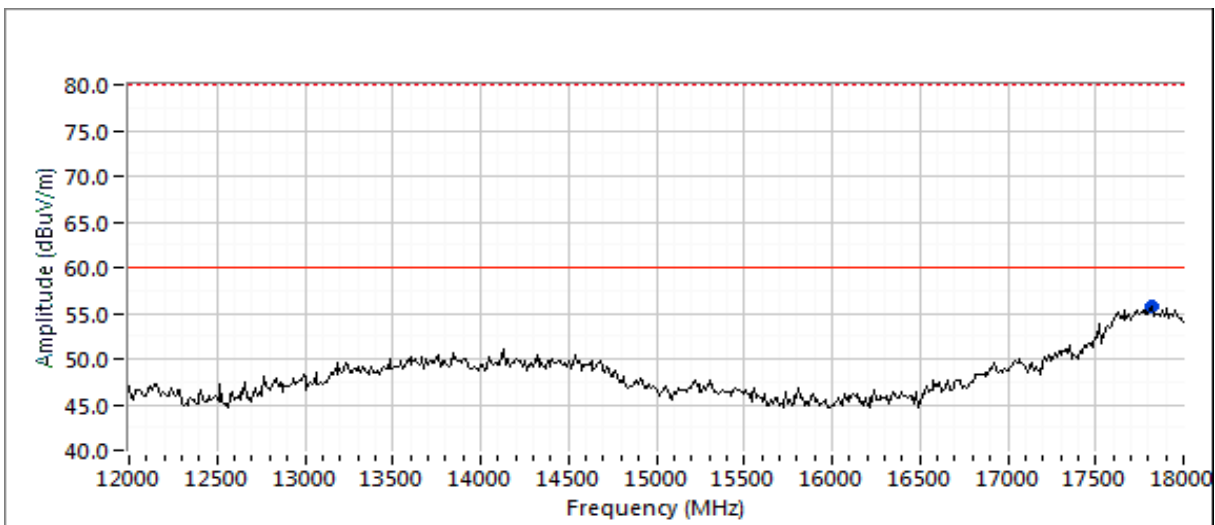
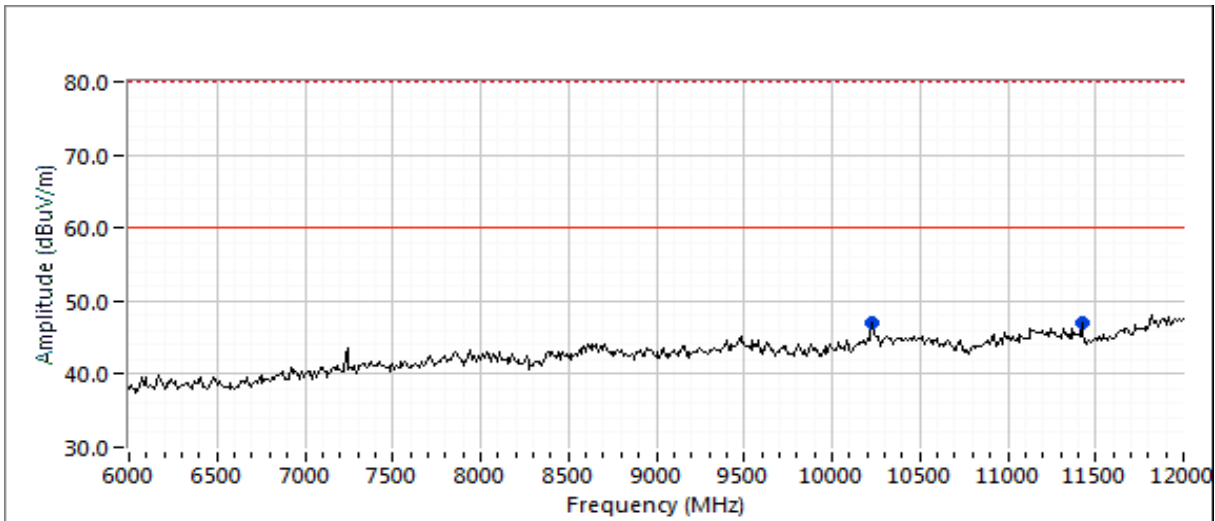
| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 25000                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

LTE modem (R204) is transmitting at 1732.5 MHz (Ch# 20175) with max power, 802.11b Ch#1 transmitting with max rated RF power (20 dBm), Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.



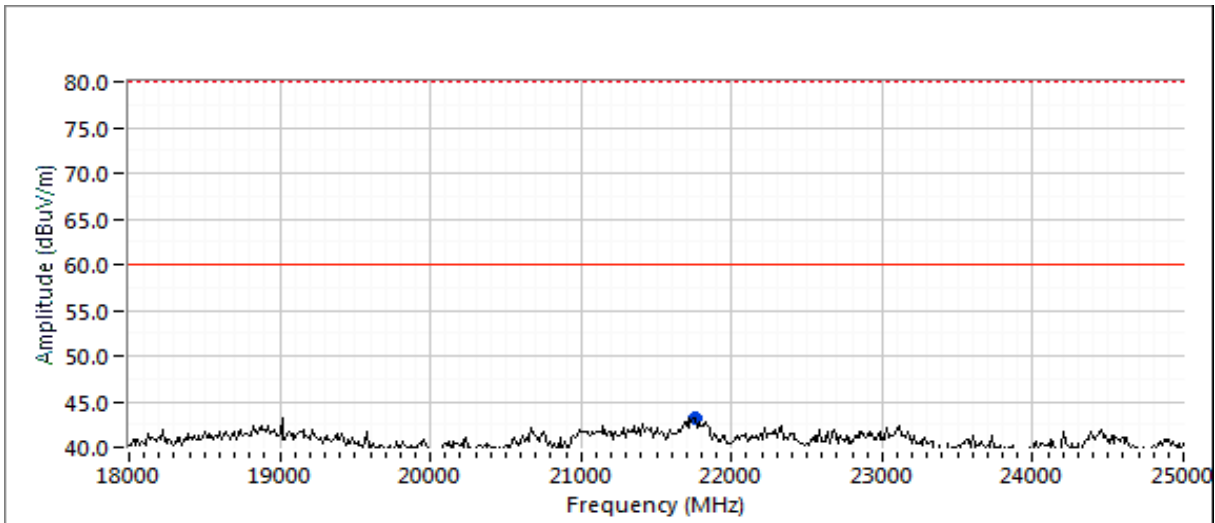
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |



### Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments                |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|-------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                         |
| 1144.290  | 62.3         | V   | -                | -      | Peak      | 24      | 1.5    | GPS- intermittent       |
| 1256.510  | 59.5         | V   | -                | -      | Peak      | 180     | 2.0    | GPS                     |
| 1732.470  | 112.1        | H   | -                | -      | Peak      | 293     | 1.3    | LTE uplink              |
| 2412.750  | 97.1         | H   | -                | -      | Peak      | 100     | 2.3    | Wi-Fi                   |
| 2132.450  | 51.5         | H   | -                | -      | Peak      | 64      | 1.5    | LTE downlink            |
| 3465.000  | 48.8         | H   | 82.2             | -33.4  | Peak      | 312     | 1.8    | LTE uplink 2nd harmonic |
| 4824.000  | 46.1         | V   | 54.0             | -7.9   | Peak      | 232     | 1.5    | Wi-Fi 2nd harmonic      |
| 10230.000 | 46.9         | V   | -                | -      | Peak      | 321     | 1.3    | Noise floor reading     |
| 11420.000 | 47.1         | V   | -                | -      | Peak      | 345     | 1.0    | Noise floor reading     |
| 17820.000 | 55.7         | H   | -                | -      | Peak      | 296     | 2.0    | Noise floor reading     |
| 21756.670 | 43.2         | H   | -                | -      | Peak      | 103     | 1.0    | Noise floor reading     |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Final peak and average readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 27 / 15.247 |        | Detector  | Azimuth | Height | Comments               |
|-----------|--------------|-----|------------------------------------------|--------|-----------|---------|--------|------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                    | Margin | Pk/QP/Avg | degrees | meters |                        |
| 4824.000  | 46.6         | V   | 54.0                                     | -7.4   | AVG       | 229     | 1.3    | RB 1 MHz;VB 1 kHz;Peak |
| 4824.120  | 52.0         | V   | 74.0                                     | -22.0  | PK        | 229     | 1.3    | RB 1 MHz;VB 3 MHz;Peak |
| 3465.200  | 56.7         | H   | 82.2                                     | -25.5  | PK        | 313     | 1.9    | RB 1 MHz;VB 3 MHz;Peak |

Note 1: For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Note 2: For Wi-Fi harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply.  
For intermodulation emissions, highest emission limit apply.



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

#### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 3/3/2020  
Test Engineer: Deniz Demirci, John Caizzi  
Test Location: Fremont Chamber #7

Config. Used: 6 (Test plan #6)  
Config Change: None  
EUT Voltage: 12 V battery

#### General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing. The remote support equipment was located outside the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Radiated emissions tests above 1 GHz to FCC Part 15 were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

**Ambient Conditions:**  
Temperature: 21 °C  
Rel. Humidity: 35-37 %

#### Summary of Results

| Run # | Test Performed                                   | Limit                              | Result | Margin                                |
|-------|--------------------------------------------------|------------------------------------|--------|---------------------------------------|
| 1     | Radiated Emissions<br>30 - 1000 MHz, Preliminary | Class A                            | Eval   | Refer to individual runs              |
| 2     | Radiated Emissions<br>30 - 1000 MHz, Maximized   | Class A                            | Pass   | 39.5 dBμV/m @ 600.00 MHz<br>(-7.5 dB) |
| 3     | Radiated Emissions<br>1 GHz - 25 GHz Maximized   | FCC Class A<br>FCC Part 27, 15.247 | Pass   | 52.3 dBμV/m @ 7205.9 MHz<br>(-1.7 dB) |

#### Modifications Made During Testing

No modifications were made to the EUT during testing

#### Deviations From The Standard

No deviations were made from the requirements of the standard.



## EMC Test Data

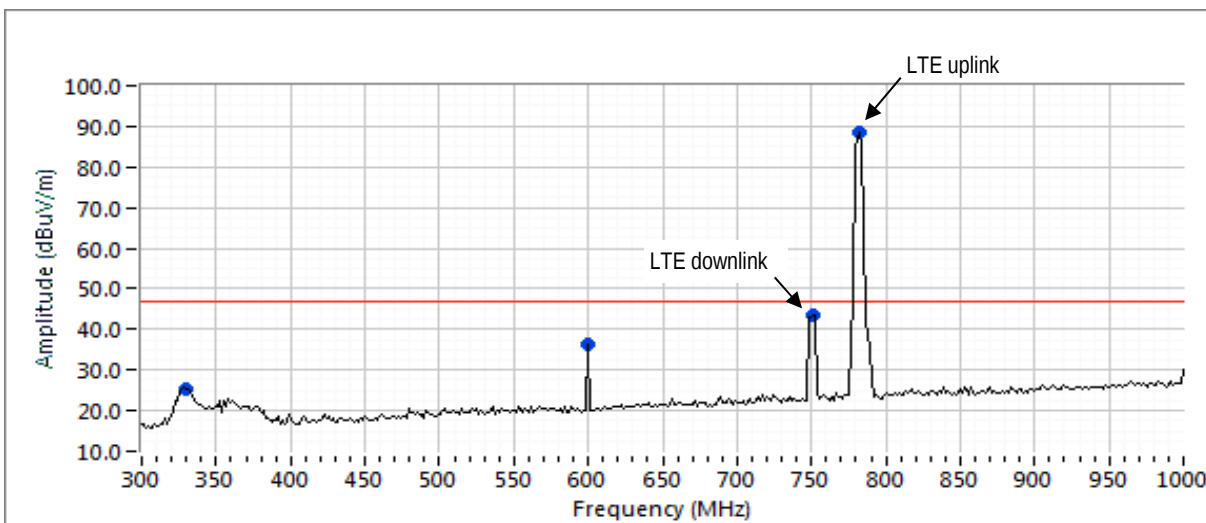
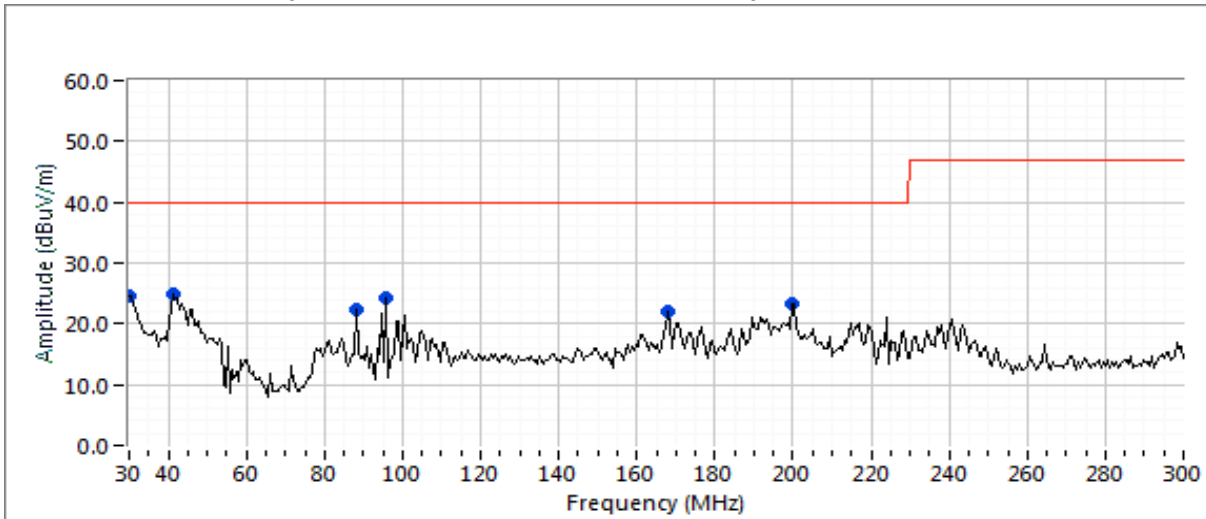
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                               | 5                         | 10                      | -6.0                                       |

### EUT and Test Configuration Details

LTE modem (R204) is transmitting at 782 MHz (Ch# 23230) with max power, Bluetooth EDR Ch#0 transmitting with max rated RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Preliminary peak readings captured during pre-scan

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments     |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|--------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |              |
| 30.000    | 24.7         | V   | 40.0             | -15.3  | Peak      | 239     | 2.5    |              |
| 41.363    | 24.9         | V   | 40.0             | -15.1  | Peak      | 24      | 1.0    |              |
| 88.437    | 22.3         | V   | 40.0             | -17.7  | Peak      | 329     | 3.0    |              |
| 96.012    | 24.2         | V   | 40.0             | -15.8  | Peak      | 192     | 1.5    |              |
| 167.976   | 22.0         | H   | 40.0             | -18.0  | Peak      | 34      | 2.5    |              |
| 199.900   | 23.4         | V   | 40.0             | -16.6  | Peak      | 185     | 1.0    |              |
| 329.459   | 25.4         | H   | 47.0             | -21.6  | Peak      | 58      | 1.5    |              |
| 600.200   | 36.5         | H   | 47.0             | -10.5  | Peak      | 2       | 2.5    |              |
| 751.003   | 43.4         | H   | -                | -      | Peak      | 60      | 3.5    | LTE downlink |
| 782.005   | 88.3         | V   | -                | -      | Peak      | 212     | 1.0    | LTE uplink   |

### Preliminary quasi-peak readings (no manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.022    | 26.4         | V   | 40.0             | -13.6  | QP        | 209     | 1.0    | QP (1.00s) |
| 42.391    | 18.2         | V   | 40.0             | -21.8  | QP        | 64      | 1.0    | QP (1.00s) |
| 88.518    | 19.0         | V   | 40.0             | -21.0  | QP        | 200     | 4.0    | QP (1.00s) |
| 94.140    | 17.5         | V   | 40.0             | -22.5  | QP        | 166     | 1.2    | QP (1.00s) |
| 200.007   | 26.2         | V   | 40.0             | -13.8  | QP        | 182     | 1.0    | QP (1.00s) |
| 600.004   | 39.5         | H   | 47.0             | -7.5   | QP        | 354     | 2.6    | QP (1.00s) |

### Run #2: Maximized Readings From Run #1

| Test Parameters for Maximized Reading(s) |                        |                         |                                            |
|------------------------------------------|------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                    | Test Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 30 - 1000                                | 5                      | 10                      | -6.0                                       |

### Maximized quasi-peak readings (includes manipulation of EUT interface cables)

| Frequency | Level        | Pol | CISPR 32 Class A |        | Detector  | Azimuth | Height | Comments   |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |            |
| 30.022    | 26.4         | V   | 40.0             | -13.6  | QP        | 209     | 1.0    | QP (1.00s) |
| 42.391    | 18.2         | V   | 40.0             | -21.8  | QP        | 64      | 1.0    | QP (1.00s) |
| 88.518    | 19.0         | V   | 40.0             | -21.0  | QP        | 200     | 4.0    | QP (1.00s) |
| 94.140    | 17.5         | V   | 40.0             | -22.5  | QP        | 166     | 1.2    | QP (1.00s) |
| 200.007   | 26.2         | V   | 40.0             | -13.8  | QP        | 182     | 1.0    | QP (1.00s) |
| 600.004   | 39.5         | H   | 47.0             | -7.5   | QP        | 354     | 2.6    | QP (1.00s) |



## EMC Test Data

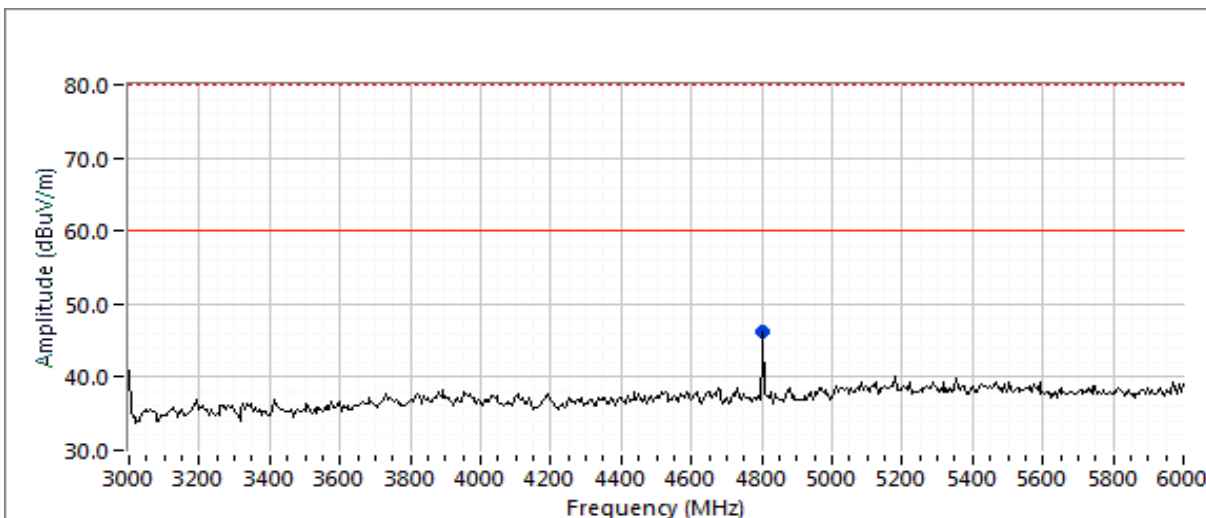
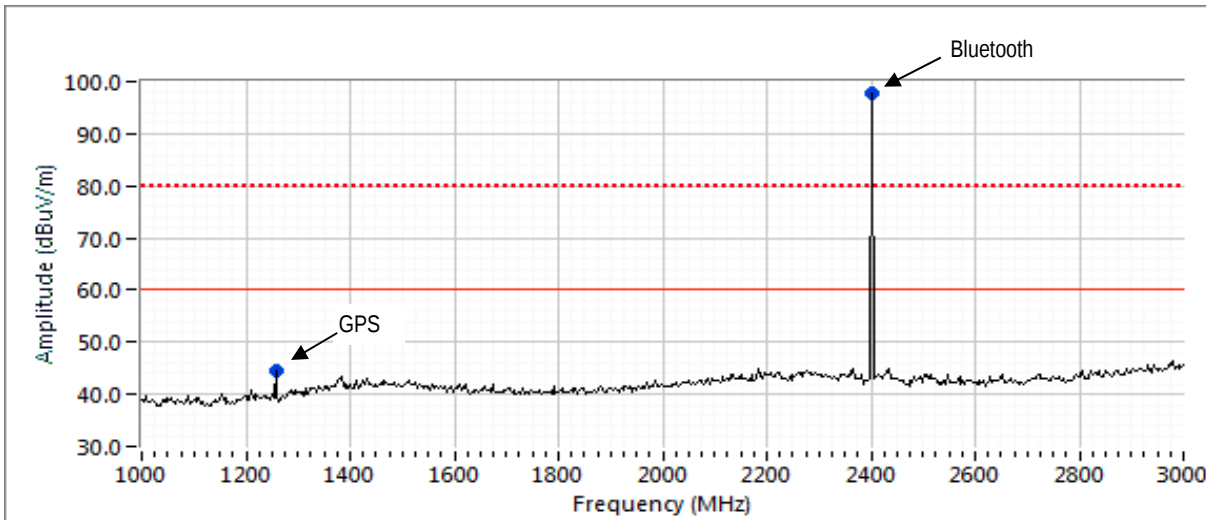
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Run #3: Maximized Readings, 1000 - 25000 MHz

| Test Parameters for Preliminary Scan(s) |                           |                         |                                            |
|-----------------------------------------|---------------------------|-------------------------|--------------------------------------------|
| Frequency Range (MHz)                   | Prescan Distance (meters) | Limit Distance (meters) | Extrapolation Factor (dB, applied to data) |
| 1000 - 25000                            | 3                         | 3                       | 0.0                                        |

### EUT and Test Configuration Details

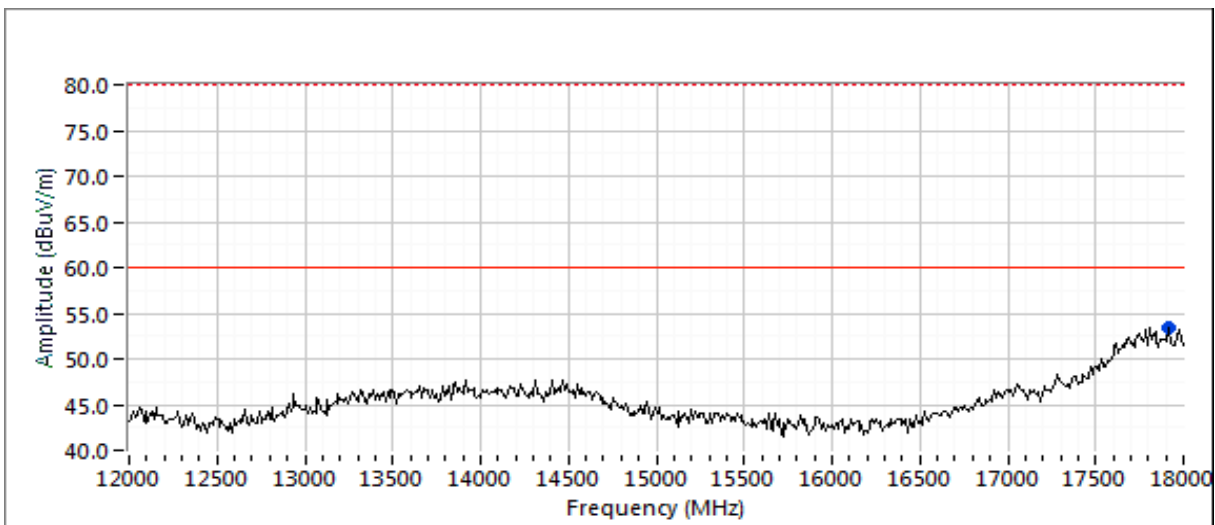
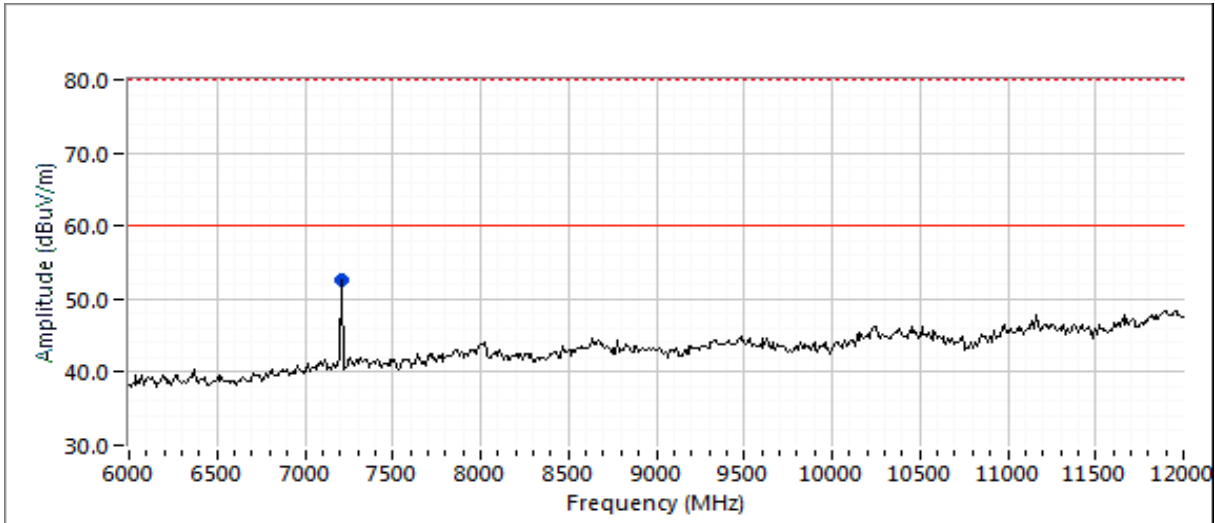
LTE modem (R204) is transmitting at 782 MHz (Ch# 23230) with max power, Bluetooth EDR Ch#0 transmitting with max rated RF power, Camera is active and writing to the SD card and USB stick. GPS is receiving satellites.





## EMC Test Data

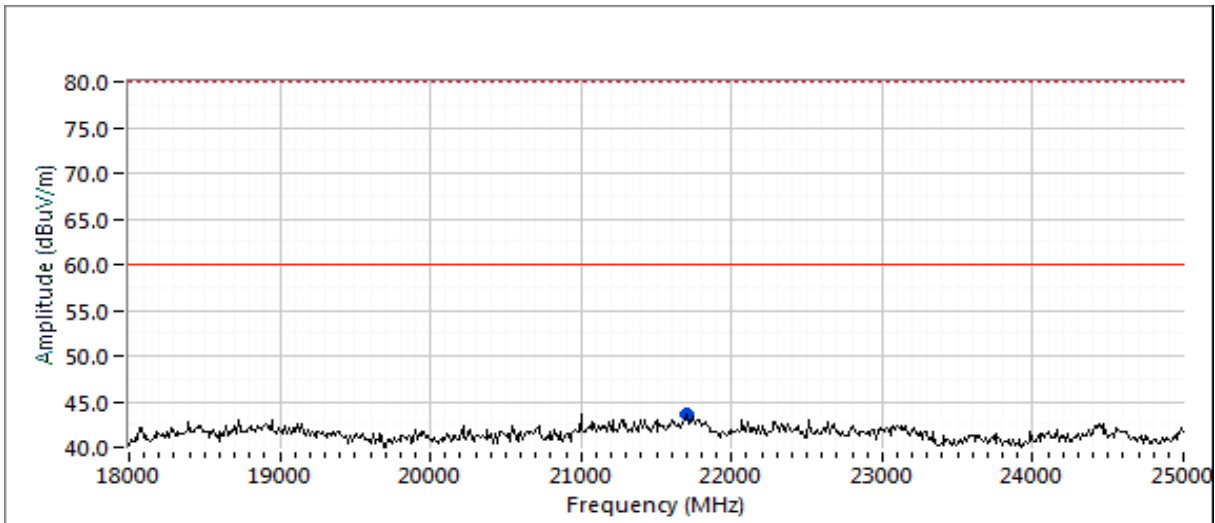
|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |





## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |



### Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

| Frequency | Level        | Pol | FCC 15 B Class A |        | Detector  | Azimuth | Height | Comments                |
|-----------|--------------|-----|------------------|--------|-----------|---------|--------|-------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit            | Margin | Pk/QP/Avg | degrees | meters |                         |
| 1256.670  | 44.7         | V   | -                | -      | Peak      | 185     | 1.8    | GPS                     |
| 2402.030  | 97.7         | H   | -                | -      | Peak      | 108     | 1.8    | Bluetooth               |
| 4804.000  | 46.3         | V   | -                | -      | Peak      | 229     | 1.3    | Bluetooth 2nd harmonic. |
| 7206.000  | 52.7         | V   | -                | -      | Peak      | 322     | 1.8    | Bluetooth 3rd harmonic. |
| 17920.000 | 53.4         | V   | -                | -      | Peak      | 210     | 1.3    | Noise floor reading     |
| 21698.330 | 43.6         | V   | -                | -      | Peak      | 154     | 1.0    | Noise floor reading     |



## EMC Test Data

|           |                                     |                   |                   |
|-----------|-------------------------------------|-------------------|-------------------|
| Client:   | Hexagon Mining                      | PR Number:        | PR113292          |
| Model:    | HxGN MineProtect OAS-LV 202 and 204 | T-Log Number:     | TL113292          |
| Contact:  | Marco Carvalho                      | Project Manager:  | Christine Krebill |
| Standard: | FCC 15B, CISPR 32, EN 301 489       | Project Engineer: | Deniz Demirci     |
|           |                                     | Class:            | A                 |

### Final peak and average readings

| Frequency | Level        | Pol | FCC 15 B Class A<br>FCC Part 27 / 15.247 |        | Detector  | Azimuth | Height | Comments               |
|-----------|--------------|-----|------------------------------------------|--------|-----------|---------|--------|------------------------|
| MHz       | dB $\mu$ V/m | v/h | Limit                                    | Margin | Pk/QP/Avg | degrees | meters |                        |
| 4803.950  | 45.7         | V   | 54.0                                     | -8.3   | AV        | 228     | 1.4    | RB 1 MHz;VB 3 kHz;Peak |
| 4804.070  | 51.6         | V   | 74.0                                     | -22.4  | PK        | 228     | 1.4    | RB 1 MHz;VB 3 MHz;Peak |
| 7205.870  | 52.3         | V   | 54.0                                     | -1.7   | AV        | 313     | 1.9    | RB 1 MHz;VB 3 kHz;Peak |
| 7206.410  | 57.7         | V   | 74.0                                     | -16.3  | PK        | 313     | 1.9    | RB 1 MHz;VB 3 MHz;Peak |

Note 1: For FCC part 15 B testing above 1 GHz, the limit is based on an average measurement. In addition, the peak reading of any emission above 1 GHz can not exceed the average limit by more than 20 dB.

Note 2: For Bluetooth harmonics, FCC Part 15.247 limits apply. For LTE harmonics, FCC Part 27 limits apply.  
For intermodulation emissions, highest emission limit apply.

## **Appendix C Product Labeling Requirements**

The following information has been provided to clarify notification, equipment labeling requirements and information that must be included in the operator's manual. These requirements may be found in the standards/regulations listed in the scope of this report.

### **Label Location**

The required label(s) must be in a *conspicuous location* on the product, which is defined as any location readily visible to the user of the device without the use of tools.

### **Label Attachment**

The label(s) must be *permanently attached* to the product, which is defined as attached such that it can normally be expected to remain fastened to the equipment during the equipment's expected useful life. A paper gum label will generally not meet this condition.

### **United States Class A Label**

This device complies with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

If the device is too small or for such use that it is not practicable to place the US label statement on it, the statement shall be placed in a prominent location in the instruction manual or pamphlet supplied in paper form with the product. If not it shall be placed on the container in which the device is marketed or on a paper insert or removable tag on the product.

For FCC, a unique identifier shall appear on the product label. The importer or manufacturer shall maintain adequate identification records to facilitate positive identification of each product sold.

### **United States Supplier's Declaration of Conformity Label**

In addition to the two-part statement detailed above, the labeling on the device may include the FCC logo.

An example of the FCC logo is shown below:



**Industry Canada**

For ICES-003 Issue 6, the product must be labeled with the following Innovation, Science and Economic Development Canada ICES-003 Compliance Label:

*CAN ICES-3 (\*)/NMB-3(\*)*

\*Insert either “A” or “B” but not both to identify the applicable Class of ITE.

If the product is too small then the text may be placed in the manual with the approval of ISED Canada.

## **Appendix D User Manual Regulatory Statements**

Where special accessories, such as shielded cables, are required in order to meet the emission limits, appropriate instructions regarding the need to use such accessories must be contained on the first page of text concerned with the installation of the device in the operator's manual.

A requirement by FCC regulations, and recommended for all regulatory markets, is a cautionary statement to the end user that changes or modifications to the device not expressly approved by you, the manufacturer, could void their right to operate the equipment.

### **United States Class A Manual Statement**

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Note: Additional information about corrective measures may also be provided to the user at the company's option.

The FCC has indicated that the radio interference statement be bound in the same manner as the operator's manual. Thus, a loose-leaf insert page in a bound or center-spine and stapled manual would not meet this condition.

### **United States Supplier's Declaration of Conformity Manual Requirements**

In addition to the manual statement(s) previously described, the following declaration shall be included in the user manual or in the documentation provided with the product:

*(company 's legal name),  
(street)  
(city, state, Zip & countr<sup>1</sup>y)  
(telephone # or internet address)*

declare under our sole responsibility that the product(s)

*(trade name(s) and model(s))*  
complies(y) with Part 15 of FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

---

<sup>1</sup> Must be a US address

## **Appendix E Basic and Reference Standards**

### **Subpart B of Part 15 of FCC Rules for digital devices.**

FCC Part 15 Subpart B references the use of ANSI C63.4–2014: “*Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*” for the purposes of evaluating the radiated and conducted emissions from digital devices.

### **Industry Canada Interference Causing Equipment Standard ICES-003 Issue 6, January 2016**

ICES 003 refers to ANSI C63.4-2014 and Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22: 10, “*Information technology equipment - Radio disturbance characteristics - Limits and Methods of Measurement.*” This standard is an adoption of IEC CISPR 22:2008-09, sixth edition, with Canadian deviations.

### ***End of Report***

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